Glasgow

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THE GLASGOW

MECHANICS' MAGAZINE;

AND

ANNALS OF PHILOSOPHY.

VOL. I.

GLASGOW:
W. R. M'PHUN, PUBLISHER.

1824.

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PREFACE.

THE present age is no less remarkable for its wonderful improvements in the Arts and Sciences, than for the general diffusion of knowledge amongst all classes of the community. No institutions have contributed more to the production of this heart-cheering spectacle than those which have been raised solely for the instruction of working Mechanics. Glasgow, "the second city of the Empire in wealth and population," had the honour of giving birth to the first institution of this nature. Nearly twenty years elapsed ere her example was imitated; but at length the City of Edinburgh founded her School of Arts. The rise of a second Institution, during the course of last year, amongst the operatives of this city, gave a spring to the march of improvement, which was sure to be attended with the most beneficial results to society. Mechanics, indeed, were every where roused from their dream of indolence by such a brilliant example of the thirst for knowledge; and institutions on the same liberal plan were founded not only in London, but in every town of note in the kingdom. The obvious effects of all this, must be the present amelioration of a valuable portion of the race, and the ultimate improvement of our Arts and Manufactures; effects more important and more worthy of the speculations of the philosopher, the description of the poet, or the contemplation of the philanthropist, as well as the attention of the public, than the muscles of an insect, the progress of a libertine, or the parallelograms of a visionary.

A powerful aid to these efforts on behalf of the Mechanics was to be expected from an engine which was felt to be powerful at the Revival of Literature—we mean the Press. The commencement of a Magazine solely intended for the use of a class of the community which had hitherto been too much neglected, was a novel and striking expedient, but one which, from its obvious tendency, was calculated to crown with success the scheme for their improvement, so well begun in the foundation of Institutions. The success of the plan has even been greater than could have been anticipated. Of this success we arrogate none to ourselves; it has been the consequence of the powerful stimulus given to philosophical and mechanical researches among the class for whom this work was designed. On reviewing our past labours, indeed, at the close of our First Volume, we feel how much we are indebted to the laudable and successful efforts of the Mechanics themselves to promote the object of their own Magazine, not only by the free communication of many of their own inventions, but by that continued support and encouragement which we have uniformly experienced. Occasionally, perhaps, we may have given a place to a communication of no great importance in itself; but, when it is considered that this encouraged not only its author, but abler individuals to come forward with other communications more ingenious and useful, the utility even of such a procedure must be obvious.

We return our sincere thanks to our Contributors in general, and to those especially, whose names appear in the work. Many valuable communications have been received from individuals, whose names we are not at liberty to mention, but to whom our thanks are no less sincerely given. We trust that they will continue to assist us in the future progress of our work, and that many new contributors, incited by their example, will join them in their laudable exertions for the advancement of useful knowledge. That many important inventions in this city and neighbourhood, have yet to be brought to light, is well known; and we hope that mechanics and others who are acquainted with them, will take a pleasure in communicating them to us for the embellishment of the Second Volume of their own Magazine. Every exertion will be made on our own part, to render it more interesting than the preceding; and we are happy to state, that from the able articles already promised in our last Number, and others which are in

progress, we have every prospect of rendering our work more useful and instructive than ever. To make it, in the words of the venerable founder of the Mechanics' Class in the Andersonian Institution, when speaking of a cotemporary work of the same description,—"the most valuable gift which the hand of Science has yet offered to the artizan," shall be our sole end and aim; and were we desirous of sounding our own praises, we might even refer to an opinion expressed by the same "high authority," namely, that "the Glasgow Mechanics' Magazine was more scientific than its cotemporary, and that the latter was merely an introduction to the former." We are, however, equally ambitious of the good opinion of our readers, upon whom we more ultimately depend for our success, and we cannot refuse ourselves the pleasure of inserting the following copy of an elegant *Round Robin* which we have received.

155, Trongate, 17*th July*, 1824.

ROUND ROBIN.

David A. Nelson.

John Stevenson.

Lachlan MacLean.

Thomas Leech.

Andrew Lockhart.

John Colquhoun, Jun.

John Mitchell.

We, the Circumscribers, sensible of the WORTH *and* UTILITY *of The* **Glasgow Mechanics' Magazine,** *(of its worth as a book soberly and ably conducted, and its utility as revealing and explicating to the public in general, the recent and daily various and prodigious achievements of Art and Science,) do hereby, collectively and individually, vote our best and sincerest thanks to the Editor or Conductor of the said Glasgow Mechanics' Magazine. And—that the First Volume is now nearly complete—we pray that said Glasgow Mechanics' Magazine may be still continued—may still receive and deserve the patronage of a discerning Public—and still retain in view its great and noble end, the informing and improving the human mind.—At Glasgow, the 1st July, 1824.*

CURLL, TYP.

THE GLASGOW
MECHANICS' MAGAZINE,
AND
ANNALS OF PHILOSOPHY.

Let Glasgow Flourish through the dissemination of Knowledge.

No. I. *Saturday, 3d January,* 1824. Price 3d.

ROYAL EXCHANGE.

PLAN OF THE WORK.

The importance of the diffusion of knowledge to all classes of the community, and especially to that class for whose use this Magazine is more particularly designed, is a truth that, we believe, is universally acknowledged. A difference, however, exists, both in opinion and in practice, as to the best means that should be employed to attain this desirable end. The most usual method to which those individuals resort, who are stimulated by a desire of obtaining useful knowledge in any branch of science, is to attend a course of lectures on the subject. Much as we approve of this mode, however, we are perfectly aware, not only from our own experience, but that of others, that it is not sufficient to gain a tolerable, and, far less, a complete knowledge of the subject of the course. Reading, regular and constant reading, is absolutely necessary to make the student an adept in that art or science which is the particular aim of his studies.

Books, therefore, must be obtained, in some way or other, to render the subjects that are continually presented to his notice, by the professor, familiar to his mind, and to bring those minutiæ of science within the reach of his understanding, which it was impossible for him to seize from the mere "winged words" of the lecture. Indeed, the student who is really in quest of knowledge, so far from being satisfied with what he hears, will only be excited to make inquiries for himself; and, aware that such knowledge can only be obtained from books, will stop at no expense within his means to procure them. Here, without putting the individual to the enormous expense of purchasing every work that may be useful to him in the pursuit of his particular study, the establishment of libraries comes to his aid; and, by the expense of a few shillings, he can generally procure a perusal of books which would otherwise have been entirely out of his reach. It is seldom, however, that books procured from a library can be retained long enough in one's possession either till they have been wholly perused, or, if so, till they have been properly digested. A book, therefore, to be useful, must be our own—we must have it to peruse early and late—and with such frequency and attention, as to render it obvious by its appearance, that we have not perused it in vain.

The pages of a magazine, conducted upon the plan we have proposed, cannot fail to come in here to the seasonable assistance of such as find a difficulty in obtaining those works which contain the information they so much desire. Do they wish to know what discoveries have been lately made in pure science? They must have recourse to the pages of the Philosophical Transactions. Are they anxious to know what progress is making in British and Foreign Arts and Sciences? They must search the contents of the various Scientific Journals. Are they desirous to know what inventions have been made, what premiums have been offered, and what patents have been obtained for new ones? They must consult the transactions of the Society of Arts and Manufactures, and the various Journals and Repositories of the Arts. And how is all this information to be obtained without an expense which very few can afford? Not by a perusal of the works themselves, which would be almost impracticable, but from the copious extracts which they will find in our Magazine. Again, does any one wish to obtain a sight or a description of any new machine, or a proper account of any old one? He must search through a variety of books and

journals, and he must inquire at a great number of individuals, who he supposes may be able to give him some information respecting the object of his pursuit, and, after all, he will often be disappointed; or, if he should be so fortunate as to learn where such a machine may be seen, or where it is properly described, he may, upon farther inquiry, find that to obtain admission into the work or manufactory where it is employed, or access to the book or journal where an account is given of it, are both equally impracticable.

It is only, therefore, in a work such as this, that he is most likely to find all his wishes in this respect gratified. In our pages, he may at last see not only a description, but a drawing of the very machine which has been the object of his fruitless inquiries; and, while he is pleased with having these in his own possession, he may be so far disappointed in finding the description fall short of his expectation, that he may be led to investigate the subject more minutely than he had hitherto done; and the result of this investigation may be some improvement in the construction of the machine, or the invention of a new one that may entirely supersede the old. Indeed, it is well known, that it was owing to this very circumstance, namely, dissatisfaction of an old machine that came into his hands to be repaired, that James Watt was led to his great improvements in the steam-engine. To a thinking mind, such as his was, the same improvements might have as readily occurred, in reading a description of the engine as in contemplating it while it stood before him. We are even of opinion, that such improvements might have more readily occurred in the former than in the latter circumstances; because the ideas are, in the one case, precisely stated and submitted to the test of investigation, while in the other, they are left to be formed by the individual himself, before they can become the subject of reflection and examination. Now, the fleeting nature of our ideas as they pass through the mind, is too well known to require any lengthened illustration of the advantages of a written description over the mere explanations of a lecturer, or the solitary reflections of an individual.

> "How fleet is a glance of the mind,
> Compared with the speed of its flight!
> The tempest itself lags behind,
> And the swift-winged arrows of light."

Many valuable branches of human knowledge are buried in the ponderous tomes of Encyclopædias; to drag which forth from these stores, inaccessible to the generality of our readers, will, in our opinion, be a real service to the industrious mechanic. We shall, therefore, not hesitate to give such extracts from these and other sources to which we have access, as we think will be of the greatest utility. And here we would observe, that the Mechanics themselves are best able to point out to us what information would be most acceptable to them. They have only, therefore, to transmit to the Publisher such notices on this head, as they think proper to write; and they may rely upon the greatest attention being paid to them by the Editor. We would also suggest, that any new ideas or questions that occur to them in the course of their reading and attendance upon the lectures of their professors, may be sent to this Magazine; whose pages shall always be open to every communication from our intelligent Mechanics. Descriptions of any new machines or engines, with

drawings of the same, will be particularly acceptable. And any new suggestion or improvement in the construction and working of machinery will be considered as highly valuable, as most properly adapted for our Work, and as most likely to be listened to through its medium.

There are Mechanics in our city, whom we could name, and many of whom we have enlisted in our service, whose communications would greatly enrich our pages, and whose continued support we earnestly solicit. To our friends at a distance, the Mechanics of Scotland in general, we shall consider ourselves very much indebted for similar communications. To them, indeed, we look forward confidently for very great encouragement in our undertaking; and if we can supply them with such branches of information as are acceptable to them, we shall not have laboured in vain. From Mechanics at a distance, particularly, we request an account of public and national works that may be carried on in their vicinity, and if accompanied by little sketches of the same, they will confer upon us an additional obligation. Indeed, every contribution to our Work will be thankfully acknowledged either publicly or privately, according to the wish of the individual.

While we are aware that we depend ultimately for our success upon our friends the Mechanics, to whose use our Magazine is entirely devoted, we are desirous of interesting all classes of the community in our favour. To them also we look for much support and encouragement, as we know that many of them are Mechanics for their own instruction and amusement. Communications and suggestions from them, therefore, will be esteemed very valuable, as they have generally more time to spare for the consideration of such subjects as are adapted for our Work, than many for whom it is more immediately designed. Indeed, we trust that through our exertions, as well as those of the Mechanics to support the credit of their own Magazine, it will be rendered a useful and instructing miscellany to all classes of society.

In pursuance of this idea, and aware that it will be highly acceptable to the Mechanics themselves, we intend, under the head of MISCELLANEOUS ARTICLES, to introduce subjects of very general interest. The accounts of the progress of the Arts and Sciences abroad, will evidently constitute an essential and interesting feature of our publication. It will be, also, both entertaining and instructive, to trace, from time to time, the history of philosophy from the remotest antiquity, and of those arts by which mankind have raised themselves, so to speak, in the scale of existence; and have left the ruder tribes of their species as far below them, in this intellectual age, as the brute creation was, in any age, below the wildest of our race. The great land-marks in the history of science, however, are those noble sons of genius who, in every age, have benefited mankind by their discoveries, and who have transmitted to posterity not merely their names, but monuments of their ingenuity, more imperishable than the pyramids of kings. To recount the memoirs of such men, scanty in many cases though they be, may elicit the latent spark of genius in many a breast, where, but for the pages of our Magazine, it might have lain dormant for ever.

> "Full many a gem of purest ray serene,
> The dark unfathomed caves of ocean bear;
> Full many a flower is born to blush unseen,
> And waste its sweetness in the desert air."

To relieve both the mind and the body after great and continued exertions, either in our daily employment, or in a regular course of study, is an object to which we think some portion of our columns should always be allotted. No species of amusement, perhaps, ever gives a purer satisfaction afterwards, or makes the mind sooner forget the toil it has undergone, than the relation or perusal of an entertaining anecdote, or interesting memoir of some illustrious individual. Such notices are seized upon by all with avidity, and we feel glad to think, while we are perusing them, that they who are the subjects of the story, notwithstanding their lofty genius, are still connected with our species by the ordinary ties of humanity. Another source of pleasure that the ingenious mind always feels, is to trace the rise of some eminent individual from the obscurity in which he formerly lived. What Mechanic has not felt his heart beat within him, when he remembered that the celebrated inventor of the modern steam-engine, who rose to such fame and opulence by his own ingenuity and industry, was once a common working Mechanic like himself? Though comparatively few, perhaps, can expect to raise themselves to the same eminence as he did, yet all have it in their power, by unremitting industry and attention to their business, to improve their condition; and if, by some lucky idea, any one should be so fortunate as to make some invention or discovery which might give a new turn to the arts and manufactures of our country, the fame and reward he would obtain, would more than repay all the trouble and anxiety that attended its progress and completion.

Notices of the history and discoveries of the various philosophical societies and academies of science in Europe, will form another interesting department of our Work. To the establishment of these societies, was owing, in a very great measure, the rapid progress of the arts and sciences in modern times. For, while the members of different societies challenged and disputed with each other, in the various questions that occur in science, mankind were benefited by their extraordinary exertions to excel their rivals, which would otherwise, it is highly probable, never have been so strongly elicited. And here we would particularly request, on behalf of the GLASGOW MECHANICS' MAGAZINE, that the Secretaries of all Mechanics' Institutions would transmit to the Publisher, copies of the Reports of their respective Institutions, and if accompanied by a historical account of their rise and progress, they will be thankfully received, and regularly inserted in our records, for the use of our readers, the Mechanics, to whom such notices cannot fail to be interesting.

In short, while the kingdoms of nature are open to our search and discovery, and her wonders continually impressing themselves upon our senses, we should undoubtedly be greatly to blame, did we not avail ourselves of the exhaustless fund which she pours around us, by selecting for our columns some of the most novel and interesting. And, while we admire the stupendous works of nature, it may not be amiss frequently to contrast them with those of art, that we may perceive how far the former transcend the latter, in grandeur of design, and simplicity of operation, and be led, by such considerations, to admire and to adore that Great Being from whom emanates all that is sublime, and beautiful, and excellent, throughout the universe.

As it is our intention to render this Magazine not only a repository of the arts, but a body of science, as well as a scientific newspaper, we shall

be particularly obliged to all who wish well to our undertaking, to transmit to us such articles as may appear to them very interesting in the course of their reading. And we would recommend to the numerous classes of Mechanics in Glasgow, who attend the Institutions for which she is justly celebrated, to form themselves into friendly societies, for the discussion of important questions in the arts and sciences, and to transmit the result of their inquiries to their own Magazine, that it may thus be considered as the philosophical transactions of such an industrious and intelligent body. In this way, they will shed a halo of scientific glory round the name of their native city; and she that has stood so proudly pre-eminent among the cities of our land, for her commerce and manufactures, may also, by their means, rise so high in the scale of intellectual superiority, as even to emulate the most learned cities in Europe.

As it will be useful to our Contributors and Correspondents to know what subjects are best adapted for our columns, and will serve as a kind of general index to the whole, we have thought it of importance to preserve the original outline of our plan in the form of the Prospectus, by placing it at the end of the present Number.

IMPROVEMENTS IN GLASGOW.

We intended to offer in this place some remarks upon the proposed new Exchange, respecting the site of which, a considerable difference of opinion exists amongst those who interest themselves in the prosperity and grandeur of our city. These remarks, however, we shall defer till some future Number of the work, when we shall probably be able to give our readers some idea of a noble building, of which the plan has been kindly submitted to our inspection, and which is proposed to be erected on the vacant space of ground that surrounds the Royal Bank. This ground should be rendered free of every obstruction, by pulling down the offices that form the wings of the present building, and extending the plan so far to the north, as to leave a street only between it and the Theatre; while a similar extent of the plan should be made by the formation of a street on the south side of the Bank. By farther extending the plan to Buchanan-Street, forming a square of elegant buildings for all the public offices in the city, with the Royal Bank in the centre, and opening a line of communication with Gordon-Street in the middle of the west side of the square, a spacious Exchange might be erected, which would not be equalled by any in the kingdom.

In the meantime, we insert the following communication with which we have been favoured, as it has a more immediate connection with the subject of our engraving.

THE NEW STREET.

The new Street which has been for some time in contemplation, and for the formation of which thirty-five thousand pounds have been subscribed, is to run in a straight line from the Cross to Monteith-Row, intersecting St. Andrew's-Lane and Charlotte-Street. At the east end, the north front will be turned off towards Great Hamilton-Street in a curved line. The open spaces at the two extremes will exhibit the most spa-

cious and striking areas in the city, both being formed by the junction, at one point, of not fewer than five streets. It is intended to make the Saltmarket one hundred feet in width at the Cross, by withdrawing from the present front of the Trades' Land—an improvement by which the opening at the Cross, already the admiration of strangers, will be rendered quite unique.

Independently of contributing highly to the ornament of the city, this Street will be of essential benefit to the population on the east side of the town. At present, the Gallowgate, which combines the disadvantage of a dangerous declivity, with the still greater disadvantage of extreme narrowness, is the only direct line of communication between the city, and the mass of manufacturing population of Calton, Bridgeton, Camlachie, Tollcross, and Rutherglen, amounting, on the lowest computation, to forty thousand persons. Added to this source of confusion, the Gallowgate forms the east entrance for one-third part of the coals consumed in the city, and for the whole of the stage-coaches and carriers' waggons, from the east and south roads. The new Street is intended to be made *level*, and nearly as wide as the Trongate at the broadest part.

In order to render the improvement complete, a turnpike road is to be formed in continuation of the street, from the east ends of Great Hamilton-Street, and Monteith-Row, in nearly a straight line to the village of Parkhead, where the London and Edinburgh roads meet.

An Act of Parliament was obtained several years ago, for the formation of a Street; and another Act, for making the Road in continuation, is to be applied for as soon as Parliament meets. We understand that the operations of taking down and rebuilding will commence early in Spring.—When the work is finished, we know not any town in Europe that will boast of having a stretch of Street so fine as Glasgow will exhibit from the head of Monteith-Row to the Gushet-house at Anderston.

DESCRIPTION OF THE GREAT BANDANA GALLERY

IN THE

Turkey-Red Factory of Messrs. Monteith & Co. at Glasgow, by Dr. Ure.

The league between science and art, which has in this country been the slow growth of necessity, was long ago effected in France, to a considerable extent, by authority of government. The illustrious minister, Colbert, fraught with the most enlightened views of state policy, founded a school of science to superintend and assist the dying manufactories of the kingdom. From that school, conducted as it has been by a succession of eminent philosophers, have emanated invaluable researches on the most beautiful, but, at the same time, most intricate of all the chemical arts—researches to which France owes much of her eminence in this very profitable branch of her national industry.

The manufactory of Messrs. Monteith & Co. has long been celebrated in the commercial world, for the excellence and beauty of its cotton fabrics. The madder-reds rival, in brilliancy and solidity, any ever produced at Adrianople; and the white figures distributed over the cloth, surpass in purity, elegance, and

precision of outline, the original Bandana designs.

The opulent and enlightened proprietors have availed themselves of every resource which the latest improvements in chemistry and mechanics could supply. In this respect, their factory deserves to be studied as a school of practical science. The permission which they have granted, of describing their discharging-gallery, is a proof of their liberality, as well as of the confidence justly entertained, that the capital and skill now engaged in their establishment are better securities for the preference which their goods possess in the European market, than the utmost mystery in conducting their processes.

Hence they have rarely refused to strangers, respectable for their rank or science, permission to visit their manufactory; a favour which it is impossible to enjoy without being gratified and instructed.

Their new arrangement of hydrostatic presses was completed in 1818, under the direction of Mr. George Rodger, senior, manager of the works. It consists of sixteen of these engines, beautifully constructed, placed in one range in sub-divisions of four, the space between each set serving as passages to admit workmen readily to the back of each press. Each sub-division occupies twenty-five feet; whence the total length of the apparatus is one hundred feet.

To each is attached a pair of patterns in lead, (or *plates*, as they are called,) the manner of forming which will be afterwards described. One of these plates is fixed to the upper block of the press. This block is so contrived that it turns on a kind of universal joint, which enables this plate to apply more exactly to the under plate. The latter rests on the moveable part of the press, commonly called the *sill*. When this is forced up, the two patterns close on each other very nicely, by means of guide pins at the corners, fitted with the utmost care. The power which impels this great hydrostatic range, is placed in a separate apartment, called the *machinery-room*. This machinery consists of two cylinders of a peculiar construction, having cylindric pistons accurately fitted to them. To each of these cylinders three little force-pumps, worked by a steam-engine, are connected. The piston of the larger cylinder is eight inches in diameter, and is loaded with a top-weight of five tons. This piston can be made to rise about two feet, through a leather stuffing, or collar. The other cylinder has a piston of only one inch in diameter, which is also loaded with a top-weight of five tons. It is capable, like the other, of being raised two feet through its collar.

Supposing the pistons to be at their lowest points, four of the six small force-pumps are put in action by the steam-engine, two of them to raise the large piston, and two the little one. In a short time, so much water is injected into the cylinders, that the loaded pistons have arrived at their highest points. They are now ready for working the hydrostatic discharge-presses, the water pressure being conveyed from the one apartment to the other under ground, through strong copper tubes of small calibre.

Two valves are attached to each press, one opening a communication between the large *prime-cylinder* and the cylinder of the press, the other between the small *prime-cylinder* and the press. The function of the first is simply to lift the under block of the press into contact with the upper block; that of the second, is to give the requisite compression to the cloth. A third valve is attached to the press, for

the purpose of discharging the water from its cylinder, when the press is to be relaxed, in order to remove or draw through the cloth.

From twelve to fourteen pieces of cloth, previously dyed Turkey-red, are stretched over each other, as parallel as possible, by a particular machine. These parallel layers are then rolled round a wooden cylinder, called by the workmen a *drum*. This cylinder is now placed in its proper situation at the back of the press. A portion of the fourteen layers of cloth, equal to the area of the plates, is next drawn through between them, by hooks attached to the two corners of the webs. On opening the valve connected with the eight inch *prime-cylinder*, the water enters the cylinder of the press, and instantly lifts its lower block, so as to apply the under plate, with its cloth, close to the upper one. This valve is then shut, and the other is opened. The pressure of five tons in the one inch *prime-cylinder*, is now brought to bear on the piston of the press, which is eight inches in diameter. The effective force here will, therefore, be 5 tons $\times 8^2 = 320$ tons; the areas of cylinders being to each other as the squares of their respective diameters. The cloth is, therefore, condensed between the leaden pattern-plates, with a pressure of 320 tons.

The next step is to admit the blanching, or discharging liquor, (aqueous chlorine, obtained by adding sulphuric acid to solution of chloride of lime) to the cloth. This liquor is contained in a large cistern, in an adjoining house, from which it is run at pleasure into small lead cisterns attached to the presses; which cisterns have graduated index tubes, for regulating the quantity of liquor according to the pattern of discharge. The stop-cocks on the pipes and cisterns containing the liquor are all made of glass.

From the measure cistern, the liquor is allowed to flow into the hollows in the upper lead plate, whence it decends on the cloth, and percolates through it, extracting, in its passage, the Turkey-red dye. The liquor is finally conveyed into the waste-pipe, from a groove in the under block. As soon as the chlorine liquor has passed through, water is admitted in a similar manner, to wash away the chlorine; otherwise, on relaxing the pressure, the outline of the figure discharged would become ragged. The passage of the discharge liquor, as well as of the water through the cloth, is occasionally aided by a pneumatic machine, consisting of a large gasometer, from which air, subjected to a moderate pressure, may be allowed to issue, and act in the direction of the liquids, in the folds of the cloth. By an occasional twist of the air stop-cock, the workman, also, can insure the equal distribution of the discharging liquor over the whole excavations in the upper plate. When the demand for goods is pressing, the air apparatus is much employed, as it enables the workman to double his product.

The time requisite for completing the discharging process in the first press, is sufficient to enable the other three workmen to put the remaining fifteen presses in play. The *discharger* now proceeds from press to press, admits the liquor, the air, and the water; and is followed, at a proper interval, by the assistants, who relax the press, move forward another square of the cloth, and then restore the pressure. Whenever the sixteenth press has been liquored, &c. it is time to open the first press. In this routine, about ten minutes are employed; that is, 16×14, or 224 handkerchiefs are

discharged in ten minutes. The whole cloth is drawn successively forward, to undergo the same process.

When the cloth escapes from the press, it is passed between two rollers in front, from which it falls into a trough of water placed below. It is finally carried off to the washing and bleaching department, where the lustre of both the white and the red is considerably brightened. By this arrangement of presses, 1600 pieces, consisting of 12 yards each, that is, 19,200 yards, are converted into Bandanas in the space of ten hours, by the labour of four workmen. The patterns, or plates, which are put into the presses to determine the white figures on the cloth, are made of lead, in the following way: A trellis frame of cast iron, one inch thick, with turned up edges, forming a trough rather larger than the intended lead pattern, is used as the solid ground work. Into this trough, a lead plate about one half inch thick, is firmly put by screw-nails, passing up from below. To the edges of this lead plate, the borders of the piece of sheet-lead are soldered, which covers the whole outer surface of the iron frame. Thus, a strong trough is formed, one inch deep. The upright border gives at once great strength to the plate, and serves to confine the liquor. A thin sheet of lead is now laid on the thick lead plate, in the manner of a veneer on toilette-tables, and is soldered to it round the edges. Both sheets must be made very smooth beforehand, by hammering them on a smooth stone table, and then finishing with a plane. The surface of the thin sheet (now attached) is to be covered with drawing paper, pasted on, and upon this the pattern is drawn. It is now ready for the cutter. He first fixes down, with brass pins, all the parts of the pattern which are to be left solid. He now proceeds with the little tools generally used by block-cutters, which are fitted to the different curvatures of the pattern, and he cuts, perpendicularly, quite through the thin sheet. The pieces thus detached are easily lifted out, and thus the channels are formed which design the white figures on the red cloth. At the bottom of the channels, a sufficient number of small perforations are made through the thicker sheet of lead, so that the discharging liquor may have free ingress and egress. Thus one plate is finished, from which an impression is to be taken, by means of printer's ink, on the paper pasted on another plate. The impression is taken in the hydrostatic press. Each pair of plates constitutes a set, which may be put into the press and removed at pleasure.

[An engraving and description of one of the presses will be given in our next Number.]

LETTERS AND QUERIES.

To the Editor of the
GLASGOW MECHANICS' MAGAZINE.

SIR,—Being desirous of obtaining some information respecting the Mechanics' Magazine, now established, and anxious to contribute to its support, by forwarding, occasionally, discoveries or inventions which have come under my own immediate notice, I would cheerfully submit them to you, if you will oblige me by satisfying me in the following particulars:

I. Is it understood, that the inventions or discoveries are to be

given *gratuitously* for the public good?

2. Must the model of a machine be actually sent, or a drawing of the model only?

3. Is any person entitled to any trifling acknowledgment, in any way, who transmits such communication for the public good?

These are merely points respecting which I am not quite satisfied, and if you will have the goodness to give me any information concerning them; you will oblige, Sir,

Your's respectfully,

N. D.

B. D. Works, 26th Dec. 1823.

For the sake of such valuable contributors, in general, and our friend, in particular, we beg leave to reply to the preceding queries:

With respect to the first and third queries, which may be answered at once, we shall be glad to receive any gratuitous communications for the public good; and occasional contributors shall not only receive our thanks, but a copy of the Magazine regularly; but if any other remuneration be deemed necessary, it shall be cheerfully given, according to the value of the communication.

As to the second query, we think that a drawing and description of the new machine is *all* that is necessary, in general; but if this is not sufficient, it will be easy to apply to the inventor for an additional explanation.

Mr. Editor,—Perhaps you may think the following queries too trifling for your Magazine; yet, let me tell you, an answer to them by any of your practical Correspondents, may be of great service to the public, and especially to

Your obedient servant,

Z.

1. What is the best means of preventing oil from collecting in the cup of an Argand lamp?

2. What is the best form for tin reflectors, to be placed above a lamp so as to spread an equal quantity of light over the floor of a room?

Mr. Editor,—I was present the other day at a dispute between two gentlemen, respecting the reduction of interest at the banks, which ran so very high, that considerable bets were taken on the subject; now, as it is not yet settled, if the question falls within the scope of your Magazine, and if any of your ingenious Correspondents could favour us with a solution, you would confer an obligation on us by inserting it.—I am, Sir, your's, &c.

R. L.

Query.—Whether do bankers gain or lose by the late reduction of interest from 5 per cent. on bills, and 4 per cent. on deposits, to 4 per cent. on bills, and 3 per cent. on deposits, supposing that they do the same business as formerly?

We insert this, as we consider it a very good arithmetical question.

MECHANICS' INSTITUTIONS.

The success of the Institution of a Mechanics' Class, in Glasgow, for many years, when none existed in any other place, led to the formation of a School of Arts for Mechanics in Edinburgh; and since the establishment of a second Mechanics' Institution in Glasgow, which has succeeded to a wonderful degree, the foundation of one

in London has taken place, under the most happy auspices. This has led to the formation of similar Institutions in several other towns both in England and Scotland, *viz.* Manchester, Leeds, Aberdeen, and Greenock.

MECHANICS' INSTITUTE, LEEDS.

It appears from the Leeds Mercury, that there is every prospect of the establishment of a Mechanics' Institute in that town. The undertaking, however, it seems, will be attended with some difficulty not experienced in the other places where the attempt has been made. In this paper it is observed, that, as the most prominent feature of the establishment, would be the regular delivery of lectures, we apprehend it would not be easy to find persons in this town, at once qualified and disposed to lecture, and they could not be engaged from other places, but at a heavy expense. In Edinburgh and Glasgow, where some of the Professors in the University have lectured gratuitously, and where scientific men are very abundant, this difficulty is not experienced. To procure a collection of models and a scientific library, both of them indispensable appendages of such an institution, would involve considerable cost.

It is necessary, therefore, that both the opulent and working classes should combine their efforts, with extraordinary spirit, to render the proposed institution practicable.

MISCELLANIES.

IRON CUTTING STEEL.

A method of cutting hard steel with soft iron, has been repeatedly mentioned in different scientific journals, and ridiculed in others, as being no new discovery, and, consequently, unworthy of notice. If the knowledge of the fact be useful to Mechanics, we do not see why it should not only be stated in a scientific journal, but actually put in practice, whether it be new or old. For it is, as Professor Playfair finely observes, "one of the prerogatives of true genius to find the highest value in things which ordinary men are trampling under their feet." Had Copernicus gone upon the principle of rejecting every fact that was not new, he would never have revived the ancient notions of Pythagorus respecting the universe; and we might, even at this day, notwithstanding the appearance of a Newton, have been as ignorant of the true system of the world as mankind were during the dark ages. We should be glad, however, to receive from any of our Correspondents a rational explanation of the curious fact in question; as we have been informed by a practical Mechanic, that the true cause is not so much the simple friction of the iron that produces such an effect upon the steel, but another cause, which we may afterwards notice, if the question be considered of any practical utility.

THE POWER OF FRICTION.

[An Original Anecdote.]

The following anecdote of a Professor of Mathematics in our University, whose memory is still famous on account of his very superior talents, will, no doubt, be amusing to our readers.

One day, a brother Professor, equally distinguished for his urbanity and wit, called upon Doctor S. whose studious habits were well known, with the intention of enjoying some friendly conversation with him. He happened, however, to call at a time when the Doctor was deeply engaged in the solution of a problem. On being shown to the door of the library or study, which happened to be standing ajar, he walked softly into the room, but was immediately arrested in his progress by the studious appearance of the Doctor. Having a profile view of his face, it was easy to perceive that he was in the midst of intense thought, with his eye fixed on the problem before him. At the same time, while he was so intent upon discovering its solution, that he did not perceive the entrance of his colleague, he was rolling an orange to and fro under his hand upon the table. His colleague, unwilling to disturb him, cautiously retraced his steps to the door, and slipped out of the room wholly unperceived. As he was passing through the lobby, however, for the purpose of taking his leave for the time, he observed a basket of turnips lying in a corner, and a thought occurring to him at the moment, he hesitated not to put it in practice. He took up one of the roundest of the turnips that he could find, and having, with his penknife, made it suitable to his purpose, he returned to the door of the library, and glided in as unperceived as before. Having cautiously approached behind the Doctor, as near as he could without actual contact, and watching the time when it lay for a little untouched, in a lucky moment, he softly, but quickly, caught up the orange, and substituted the turnip in its place. He then endeavoured to retire with the utmost silence and speed with his trophy, and succeeded not only in leaving the room unnoticed, but in escaping unperceived out of the house into the court, where he waited the result of the experiment. While walking about for some time, he collected two or three of his brother Professors who were passing, and having let them into the joke, they impatiently expected the issue. Not long after this, the door of the mathematician flew open, and he, with his head bare, and his clothes in dishabille, came running up into the midst of them, and exclaiming, with the most evident sign of astonishment, "A discovery, gentlemen, a discovery; I have changed an orange into a turnip, by the simple power of friction." This assertion produced such a universal fit of laughter, that the Professor was more astonished than ever, and he could hardly be persuaded, after an explanation of the joke, that the fact had not actually taken place.

IMAGINATIVE PHILOSOPHERS.

It is a great mistake to suppose, that a philosophical spirit is in direct contradistinction to an imaginative one. On the contrary, the highest order of thinkers and discoverers, such as Bacon, Newton, and Leibnitz, are mainly indebted to the imaginative faculty. A case in point:—The latter, when occupied in his philosophical reasonings, on his "Law of Continuity," was enabled, by his singular sagacity, to predict a discovery which was afterwards realised,—he imagined the necessary existence of a polypus. The supposition of Columbus, in regard to the existence of a western continent, was also imaginative.

OLD STYLE IN RUSSIA.

Question.—"Why is the old style still preserved in Russia?"

Answer, by a witty foreigner.—"That they may believe themselves only twelve days behind the rest of Europe, whereas their arrears exceed a century."

SCOTCH AND ENGLISH.

The Scotch understanding differs from the English, as an Encyclopædia does from a circulating library. An Englishman is contented to pick up a few odds and ends of knowledge; a Scotchman is master of every subject alike. In England, each individual has a particular *hobby*, and favourite bye-path of his own; in Scotland, learning is a common hack, which every one figures away with, and uses at his pleasure.

ASTRONOMY.

Solar Spots.—A large spot, rather of an uncommon size, has been traversing the sun's disk, for eight or ten days past. It appears to be about the 90th part of the sun's diameter, and is, consequently, about 9000 miles in breadth. When seen through a telescope, magnifying about 80 times, it appears nearly of the figure of an irregular pentagon, surrounded with an *umbra*, or faint shade, of exactly the same figure, which is a presumptive proof that the spot and the umbra are intimately connected; and the question is, whether such an appearance proceeds from an immense excavation in the sun's body, or from a huge prominence rising from his surface. This spot is now verging towards the north-western part of the disk, and will disappear in two or three days. It may be distinctly seen with a telescope magnifying six or eight times. Another spot of much smaller dimensions, may also be seen approaching the sun's centre. For some time past, few large spots have been observed on the disk of this luminary.

Venus is now a morning star, and appears like the moon about five or six days previous to change. At present, those who have telescopes may observe a large spot on her disk, near the northern cusp.

A comet is now visible in the mornings, two hours and a half before sunrise. It is situated in the south-east, about 15 degrees above the horizon. The nucleus, or body of the comet, appears small and ill-defined, but the tail is brilliant.

NOTICES.

We understand that a Compendium of Practical Mechanics, with numerous Tables, particularly adapted for the use of Operative Mechanics, will appear in Glasgow about the end of January.

We learn that Dr. Thomson's new work will be entitled, ' An Attempt to establish the True Atomic Weights of Chemical Bodies."—The Author has been assiduously occupied in investigating the subject for nearly five years, and his experiments are now approaching a conclusion. The work will contain the composition of several hundred salts actually determined by analysis; and the simplicity of the relations of the atomic weights to each other, will be established by a vast number of experiments.

PROSPECTUS.

The object of this Magazine is, to supply the Mechanics of Glasgow, and of Scotland in general, with a useful and interesting Miscellany of Original and Select Articles on subjects connected with their various and diversified pursuits. It is obvious, therefore, that this view of our Plan extends to the whole range of the Mechanical Arts and Sciences; and while our design is to present to our Readers a complete history of the progress of human invention and discovery, they may rest assured, that whatever tends to the elucidation of Theory or the simplification of Practice, will find the readiest admission into our columns.

ARTS, MANUFACTURES, AND MACHINERY.

Under this division, will be comprehended an account of every improvement that occurs in the practice of the Mechanical Arts, particularly in the construction of Machines, Steam-Engines, Steam-Vessels, Carriages, Wheels, Screws, Cranes, Common, Printing, and Hydrostatic Presses, &c.; in Brass and Iron

Founding, Civil Engineering, Mill-Work, Clock-Work, Carpentry, Ship-Building, and Architecture; in the construction and use of Philosophical and Chemical Hygrometers, Air-Pumps, Water-Pumps, Diving-Bell, Electric Machines, Galvanic Batteries, Microscopes, Telescopes, Magic Lanterns, Camera Obscura, Micrometers, Goniometers, &c.; in Bleaching and Dying Processes; in Linen, Cotton, Woollen, and Silk Manufactures; in Brewing and Distillation; and in Printing, Drawing, Painting, Steel, Copper, Wood, and Stone Engraving.

MECHANICAL AND CHEMICAL SCIENCES.

This division will comprehend an account of all the discoveries that are daily making in these Sciences, but especially in Chemistry and its cognate Sciences, Magnetism, Galvanism, and Electricity; observations on the improvements and experiments in Theoretical and Practical Mechanics, relative to the Mechanical Powers, Mechanical Agents, motions of Machinery, strength and pressure of Materials, &c.; in the principles and construction of wooden, stone, iron, and suspension Bridges, Piers, Arches, Domes, &c.; in the Sciences of Hydrostatics, Hydrodynamics, Aerostatics, Pneumatics, Acoustics, Optics, and Physical Astronomy; in Crystallography, Meteorology, Mineralogy, Botany, Natural History, Geology, and Organic Remains.

Under this division may also be included, an account of improvements in the pure and mixed Mathematical Sciences, at least, in so far as they can be rendered intelligible without much previous study. Notices of Astronomical, Geographical, and Nautical Discoveries, and of expeditions for the purpose of making philosophical experiments and observations in various parts of the globe.

PUBLIC WORKS.

Under this department, the earliest notices will be given of the progress and success of all public and national undertakings; such as the making of Canals, Bridges, Aqueducts, Tunnels, Roads, and Railways; the embankments and deepening of Rivers; the erection of Piers, Docks, Harbours, Breakwaters, and Lighthouses; the raising of Public Edifices, Churches, Spires, Monuments, Statues, extensive Manufactories, Cotton Mills, Iron Works, &c.; the opening, and modes of working Mines, Coal-Pits, Quarries, &c.; and an account of Trigonometrical Surveys, Levelling, Geodesic Operations, Altitudes of Mountains, Measurement of a Degree on the Earth's Surface; and various other inquiries connected with the past and present states of the Globe.

MISCELLANEOUS ARTICLES.

As this MAGAZINE is intended to be a store-house of instruction and amusement, for the use of our industrious Artizans, who, in general, cannot afford to purchase very large and expensive works, there will be inserted, under this head, a variety of interesting articles on subjects of general information; such as, the most recent notices of the progress of Foreign Arts and Sciences; the history of Philosophy, from the earliest ages to the present time; Biographical Notices of eminent Philosophers, Mathematicians, and Mechanicians; the history of the rise and progress of Mechanical and Philosophical Institutions; accounts of Natural and Artificial Curiosities and Antiquities, in every quarter of the Globe; descriptions of the Wonders of Nature and Art, such as Earthquakes, Volcanoes, Water-Spouts, Water-Falls, Fiery Meteors, Meteoric Stones, &c.; and Pyramids, Subterranean Ruins, Remains of Ancient Grandeur, exhibited in Amphitheatres, Temples, Pagodas, Mausoleums, Colossuses, Labyrinths, Walls, &c.; and a list of Patents obtained for Inventions, and of all Premiums offered for Improvements, Inventions, Discoveries, and Essays, both at home and abroad.

ADDRESS.

MECHANICS OF GLASGOW,

WE congratulate you most cordially upon the success which has crowned your exertions in the noble cause of intelligence and freedom. For a

period of twenty years, you have stood pre-eminent above your fellow-mechanics in this Island, for the great extent of your scientific knowledge, and for the wonderful improvements you have made in the Arts and Manufactures, for which we have long been distinguished. By this means, combined with other circumstances, you have raised your native city to a pitch of opulence and grandeur, unrivalled by any other city in the kingdom. At length, the meed of fame has been awarded you; and while your superiority as intelligent Mechanics, is acknowledged throughout Europe, your example is now about to be imitated in every city of importance in the empire. The noble flame of emulation which you have kindled, has even reached to the metropolis itself; and the torch of science which has so long shone within the walls of your Institutions alone, is about to cheer, with its reviving gleams, many thousands of her industrious sons. The foundation of a London Mechanics' Institution, is an event which should, therefore, stimulate you to redouble your exertions to preserve that superiority which you have so long maintained.

No plan can be more conducive to this purpose, than the publication of the Glasgow Mechanics' Magazine, a Work which only requires your support to render it eminently successful. In this publication, you will always find instruction and amusement of the noblest kind; and while your attention may be arrested by an interesting account of some curious invention or discovery that may have been made in some different quarter of the globe, a thought, quick as the lightning's flash, may occur to your mind, that may be the germ and the fruitful parent of some noble improvement, or even nobler discovery, of your own.

While this Work, therefore, will contain an original and distinct account of all the improvements and discoveries that are made in the Arts and Sciences abroad, upon you, in a very great measure, must it depend for a similar account of all those that are made at home. To you, we the more readily make this appeal, as we feel confident that it will not be made in vain, and that you will embrace this very favourable opportunity, of raising, in the pages of the Glasgow Mechanics' Magazine, a durable monument to your fame. Your contributions, in the form of Essays, Letters, &c., containing accounts of Improvements, Discoveries, and Inventions in Arts, Sciences, and Manufactures—Reports of the progress of Public Works, or Manufactories, in which you are concerned—Statements of the trial and the success or failure of any new Engines, Machines, or Instruments—and details of new experiments in Chemistry, Mechanics, and the various branches of Natural Philosophy, will be received and highly valued by the Editor, and will be most readily inserted in our Magazine.

No. II. will be published on Saturday, the 10th of January; and will contain, among other interesting Articles, a Sketch of an Excellent Plan for a safe and commodious Harbour in the Clyde, by an experienced Ship-master; an original account of the New Patent Waterproof Cloth, invented by Charles Mackintosh Esq., Glasgow; and No. I. of a series of articles on the Principles of Natural or Mechanical Philosophy, &c. &c.

NOTICES TO CORRESPONDENTS.

D. D. on the "Eidouranion" in our next.—R. S. does not suit our plan.—M. will be duly considered, and, if not found wanting, will be inserted. The communication containing a report of Mr. Steele's Lecture on Caloric, was too long for insertion.

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J. CURLL, PRINTER.

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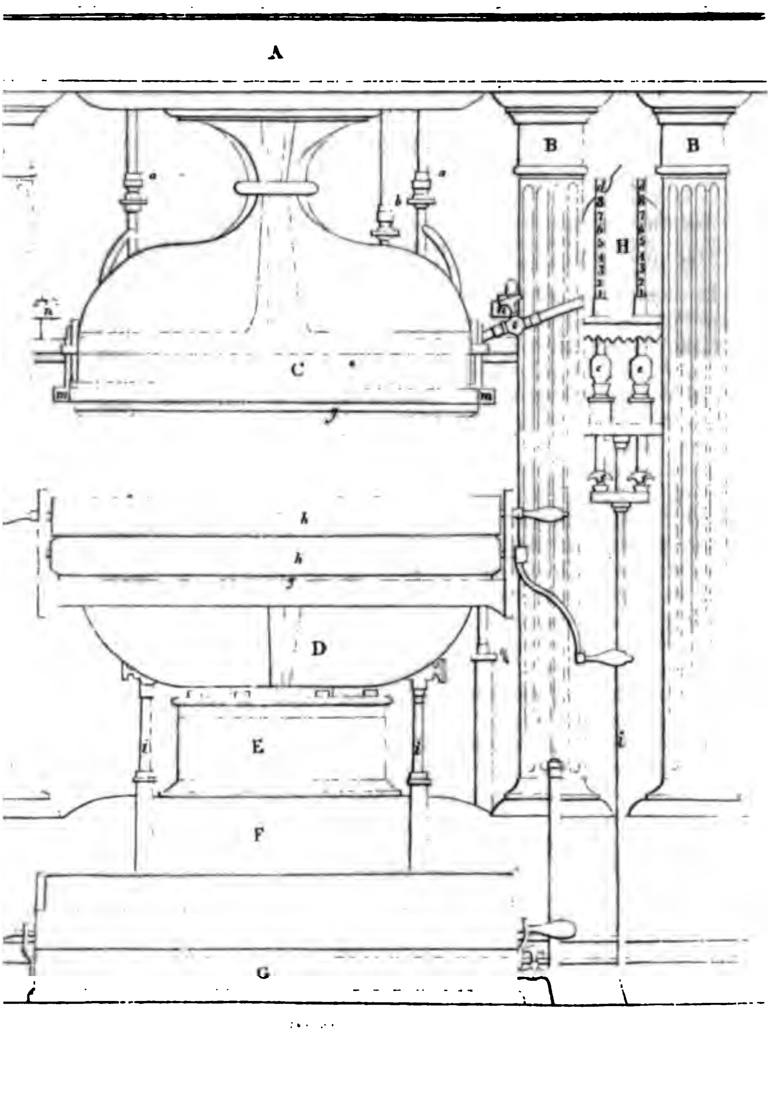
THE GLASGOW MECHANICS' MAGAZINE.

" Knowledge is power."—*Bacon.*

No. II. *Saturday*, 10*th January*, 1824. Price 3*d.*

HYDROSTATIC PRESS,

Employed in Messrs. Monteith & Co.'s Turkey-Red Factory.



Description of the Engraving.

This plate is an elevation of the press; A, the top, or entablature; B B, cheeks of ditto, or pillars; C, upper block, to which the upper pattern is fastened; D, lower, or moveable block; E, the cylinder; F, the sole, or base; G, the water-trough to contain the discharged cloth; H, the cistern, or liquor-metre; *d d*, glass tubes for indicating the quantity of liquor in the cistern; *e e*, glass stop-cocks, for admitting the liquor into the cistern; *f f*, stop-cocks, for admitting water; *g g*, the pattern plates; *n n*, screws for setting the patterns parallel to each other; *m m*, snuggs perforated with a half-inch drill. The lower iron frame has corresponding pins, which suit those perforations, so that the patterns are guided into exact correspondence with each other; *h h*, rollers, which receive and pull through the discharged cloth, from which it falls into the water-box; *k*, stop-cock, for filling the trough with water; *i i i*, waste tubes, for water and liquor.

PLAN FOR A SAFE AND COMMODIOUS HARBOUR IN THE CLYDE.

To the Editor of the

Glasgow Mechanics' Magazine.

Sir,—The commerce of Glasgow has now increased to such an extent, that the present accommodation for its shipping, is quite insufficient to admit of vessels getting births for the purpose of discharging and loading at the same time. The delay thus occasioned, is the source of great inconvenience to the ship-owner and merchant. During winter, especially, this inadequacy of accommodation renders mooring in the present harbour exceedingly unsafe; because, in the event of a severe and continued frost, during which the ice may become a foot thick, if it be followed by a rapid thaw, accompanied with rain, it would be quite impossible to prevent the vessels next the bridge from being broken adrift by the rush of the ice. Now, lying as they do generally, five or six abreast, and in extreme cases, even a greater number, if once they be driven from their mooring, they would, in all probability, carry the rest along with them, and it is difficult to calculate the loss of lives and valuable property that might be the consequences of such an event. Past experience has indeed shown, that such consequences may be expected, and that in a greater degree, in proportion as the trade of the city increases.

To remedy these defects, many plans have been proposed; but none of these which I have seen, is calculated to afford accommodation, both ample and secure.

After examining the harbour with considerable pains, I am of opinion, that the most eligible means that could be adopted for this important purpose, would be the construction of a wet dock. The best place for the construction of this dock, would be that green plot of ground, situate on the south side of the Clyde, immediately under the Broomielaw bridge, and extending down opposite the end of the old quay. This dock should

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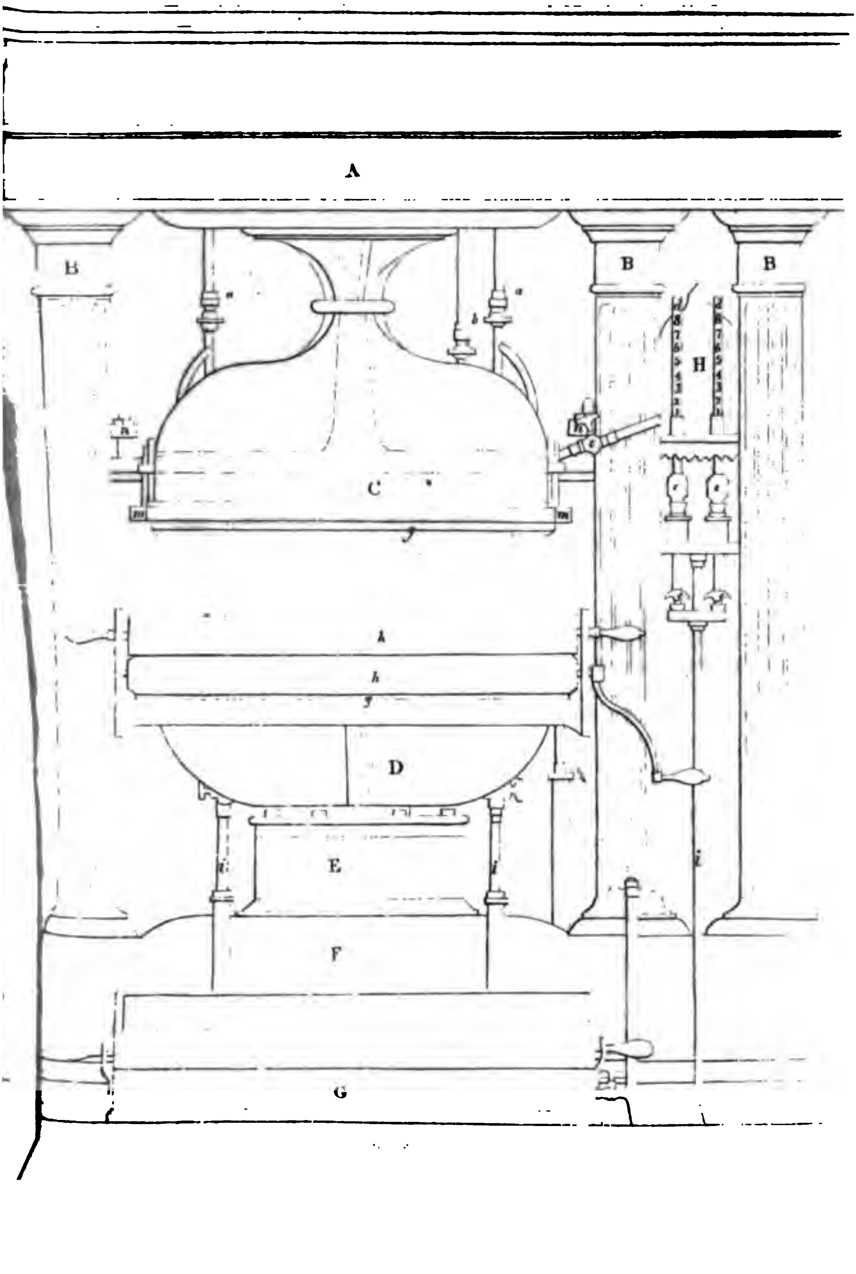

ON THE ASTRONOMICAL MACHINE CALLED THE EIDOURANION: OR, LARGE TRANSPARENT ORRERY.

Mr. EDITOR,—Perhaps the subject of the following communication is still so recent, as to render it interesting to many of your readers; if so, your inserting it in your Magazine, will much oblige, SIR,

Your most obedient servant,

D. D.

SELDOM has the sublime science of Astronomy been more beautifully illustrated and explained, than by Mr. Walker's very ingenious machine, called the Eidouranion, *i. e.* an idea of the heavens. Nor is the science less indebted to the lecturer for that deep enthusiasm which he infuses into his lectures, and which carries his audience along with him through the boundless regions of space, and, not unfrequently, with true devotional feeling, from "nature's self, even up to nature's God."

The lecturer commenced with a short sketch of the history of the science, and then, in a very plain and familiar manner, he endeavoured to convey to the younger part of his hearers, the first correct notions of the true figure and motions of the earth. This part of the lecture was indeed both amusing and instructive to many who had formerly made this science the subject of their study, and who were, consequently, able to appreciate the merits of these beautiful illustrations.

The audience were next delighted by a most ingenious demonstration of the truth of these notions respecting the figure of the earth, as well as of the existence of the Antipodes, by means of a beautiful transparent globe, about six feet in diameter. All at once, however, the scene began to change; and, while the Celestina was giving an idea of the music of the spheres, the Sun burst forth with his ever-moving rays, illuminating the one-half of an elegant transparent revolving globe, two feet in diameter, while the other half was enveloped in darkness; a representation which distinctly showed the circle of perpetual illumination, at one time enlightening the north pole, and then, by degrees, the whole frigid zone; and at another, receding from the pole again, in the same manner, till it was lost in semi-annual darkness.

Meanwhile, the apparent progress of the Sun, or, the real progress of the Earth, through the signs of the zodiac, and the changes of the seasons, were finely elucidated, by a most beautiful transparent painting of these signs, that surrounded the machine, and was comprehended in a circle of about 20 feet in diameter.

After some familiar, but accurate explanations of the phenomena of the moon, our attention was again arrested by the novelty of another scene, not inferior to the former. A fine representation of the phases and eclipses of the moon, by means of two transparent globes, of the earth and her satellite, revolving round the sun, was exhibited, and accompanied in the fore-ground, by an exquisite transparent painting of all the mountains in the world, which were remarkable either for their great elevation or volcanic eruptions; compared with which, the works of man—his pyramids and temples—dwindle into utter insignificance. On the right and left, were also to be seen some beautiful transparent paintings of the telescope appearance of the moon, with seas, "rivers, and mountains, on her spotty globe."

The third scene, though less grand and imposing than any of the preceding, or succeeding, was by far the most novel and interesting of the whole. Here the lecturer again endeavoured to convey, in an amusing manner, even to the youngest mind, an idea of that wonderful power called the attraction of gravitation, which exists in the moon, and causes the tides of the ocean both to ebb and to flow. His mode of reconciling anomalous facts was remarkably ingenious, and, in our opinion, satisfactory.

While the tides, in general, follow the law of the moon's motion, and flow from north to south when she is on the meridian; yet the seeming exceptions in the Irish sea, on the shores of the West Indies, and in the Mediteranean, require some explanation.

It is well known that the tides run with an amazing velocity (some say, at the rate of ten miles an hour) through the Pentland Frith, and round the North and West Coast of Scotland; but that not finding an easy passage through the North Channel, on account of the near approach of the sister islands, they run round the West Coast of Ireland with such rapidity, that it is high-water at Cape Clear before it is high-water at Cork, at Cork before Dublin, at Dublin before the Isle of Man, &c.; and that they run with such force up the Bristol Channel, that they often rise at Chepstow, to the astonishing height of sixty perpendicular feet.

Here the lecturer stated, that the sole cause of this phenomenon is, that the Irish sea, forming a large hollow basin, as it were, for the water, the sea rushes in, as it doubles the Cape, to the lowest place, or, in other words, till it finds its level; and thus the tides seem to run contrary to their natural order. He accounted for the smallness of the tides on the shores of the West Indies, which never rise above six or eight inches, by supposing, that the trade-winds, which have been blowing from east to west ever since the world began, drive the tides with such violence through the Caribbean sea, between the West Indies and South America, that they have formed a perpetual current round the Gulfs of Mexico and Florida. He even suggested, that this current may have washed away the soil that perhaps once united the West Indies with the mainland, and that, possibly, North and South America were once more closely connected by land than they are at present, but that the constant trituration of the water, has, ultimately, formed a sea and a gulf, where formerly may have stood a part of the great Western Continent.

Much has been said upon the vast importance of which it would be to commerce, if a canal, or passage, were cut through the Isthmus of Darien, or Panama, between the Atlantic and Pacific Oceans. Although he admitted, however, the utility, he doubted the practicability of the project; for he believed that if a canal were cut, the waters would soon find a passage for themselves, the level of the Atlantic being higher than that of the Pacific; but that, being driven with such rapidity through that passage, they would form such a current, that there is no doubt of vessels being carried through; he believed, however, that there would be little danger, if once they were carried through, of their ever finding a passage back again.

The current which has thus formed the Gulf of Mexico, runs with such rapidity round Cape Florida, that the tides in the bay of Fundy, rise sometimes to the very remarkable height of eighty or even ninety perpendicular feet; and that

this current is so well known to mariners sailing to Europe from any part of South America, or the West Indies, that they allow their vessels to sail with it through these places, and are carried by it away off the banks of Newfoundland, far on their passage home.

The strangest anomaly of all, however, is the remarkably small tides in the Mediterranean, although it is well known that there is a current continually running in at the Straits of Gibraltar; while there seems to be no apparent outlet for the constant influx of the tides, and of those mighty rivers, both in Europe and Africa, that disembogue their waters into the great basin of this inland sea.

Mariners generally account for this deficiency of tides, by stating, that there is a constant outlet-current considerably below the surface of the Straits, so that as fast as water runs in above, so fast does it run out below; and this they prove, by stating, that when a plumb-line is thrown into the sea, at the Straits, it is left far behind the ship, as appears when it is drawn up again; which shows that the line is carried out, while the ship is carried in, whereas, were the current the same below as above, the line would be carried in along with the ship, or even before it.

This, however, is not considered a satisfactory explanation, because it not only seems contrary to nature, but seems merely to prove that the current is more rapid at the surface than below it. The opinion of Lord Valencia seems to be the most satisfactory, namely, that the Mediteranean has a subteranean outlet, at the Isthmus of Suez, into the Arabian Gulf. His reason for this opinion was stated to be, that a strong tide, or current, runs continually down this Gulf, from north to south, while, apparently, little or no tide runs in at the Straits of Babelmandeb. Be this as it may, however, there can be no doubt, although the explanation of these anomalous facts may be questioned, that the true cause of the tides is the attraction of the moon, in whatever way it may be modified, by the peculiar situation of the seas that are affected by its influence.

The fourth scene was a grand display of the Solar System, in which we first beheld a fine representation of the sun setting behind a beautiful expanse of waters, tinged, in one place, with his saffron-coloured rays, and, in another, with the azure blue of the vault of heaven.

We then beheld, in succession, Mercury, Venus, Mars, the four new planets, Vesta, Juno, Ceres, and Pallas, Jupiter with his belts and four moons, Saturn, with his rings and seven moons, and the Georgian Sidus, with his six moons, all revolving in beautiful array around the sun, the great primary of the whole. At the same time, the motions of these different planets on their axes, and of their satellites round their primaries, was very successfully represented by the machine. The lecturer here launched out into the wide field of description, and gave a very full account of the magnitudes, motions, and distances of the different planetary bodies, all tending to raise our ideas of the splendid frame of nature, and to give us a proper notion of the situation and importance of the globe we inhabit, with respect to the other bodies in the system.

The fifth and last scene was, unquestionably, the finest of the whole. The approach of night was admirably imitated by the machinery employed, and the spangled appearance of the firmament, with the milky way, "powdered with stars,'

had a very striking resemblance to nature. By this device, indeed, the lustre of the planets was considerably heightened, and the whole scene was rendered interesting by the approach and recession of a comet, in its eccentric orbit round the sun, which were very ingeniously represented. At this scene, the lecturer seemed evidently to be overpowered by the grandeur of the subject, and could not but quote those beautiful lines of Milton, so appropriate to the feelings on such an occasion:—

These are thy glorious works! Parent of good!
Almighty! thine this universal frame,
Thus wondrous fair: thyself how wondrous then!
Unspeakable! who sit'st above these heavens,
To us invisible, or dimly seen
In these thy lowest works: yet these declare
Thy goodness beyond thought, and power divine.

When we stretch our ideas into infinite space, and contemplate the systems, without number, that fill it, we have, indeed, a subject truly worthy of the Deity. Such is the order and grandeur of the celestial world, that the farther we pursue our discoveries in it, we are more and more lost in admiration.

To conceive that every one of the millions of stars that we see, is a sun, and the centre of a system similar to ours, and that every one of these worlds may be inhabited by intelligent beings, is so overwhelming to our limited faculties, that the astonished imagination becomes bewildered, till, at length, it is entirely lost and sunk in the abyss of nature. Well might the Psalmist say, that "the heavens declare the glory of God, and the firmament showeth forth his handywork." Well might he express himself as overwhelmed with the idea of the power and omnipresence of the Deity; since all our discoveries serve only to convince us that a progress of inconceivable extent, continued through ages without number, would find us every where, as here, surrounded with his infinite goodness, and filled with the idea of his eternity and immensity.

ON THE PATENT WATER-PROOF DOUBLE FABRICS,

Invented by Charles Macintosh, *Esq. of Crossbasket.*

CAOUTCHOUC, or, as it is more generally termed, Indian rubber, was first introduced into this country, from South America, about the beginning of the last century. It is procured in South America, and in the East Indies, from certain trees, which, on holes being made in them, give out a milky substance, which, as would appear from the researches of the French Chemist, Fourcroy, combines with oxygen, when exposed to the atmosphere, and assumes the solid form. For the purposes of commerce, it is commonly put into the shape of bottles, by spreading a thin coating of the milky substance over a clay mould, and drying this coating in smoke, from which it derives its black colour, (for it is naturally white,) and when dry, putting above this, in like manner, such a number of coatings as will produce the requisite degree of thickness.

The singular qualities of caoutchouc, its softness, its elasticity, joined to its power of resisting water, have long pointed it out as a likely means of producing flexible water-proof fabrics, for cloaks, shoes, hats, and the like. For this purpose, the great object has been, to find a solvent of it, which, upon evaporation, will leave the caoutchouc with the same qualities which it possessed before the solution; just as water dissolves starch, ad-

mits of the solution being spread on cloth, or being impregnated in it, and dries, leaving the starch unchanged in its qualities.

Now, three such solutions have been proposed at different times. The first was sulphuric ether; which, though it does effect the solution, yet, as it must be pure, and as it is exceedingly expensive, is out of the question for common purposes. The second solution proposed, was oil of turpentine; which, however, was found so difficult to dry, that it has been abandoned. The third was rectified coal-oil, or naphtha, as it is called; this oil is a more powerful solvent than the former, and it dries more readily, but still so imperfectly as to leave the caoutchouc clammy, and too devoid of firmness to bear any of the fatigues of wear.

Such was the progress that had been made previous to the invention which is the more immediate subject of this notice.

Mr. Macintosh's process is exceedingly simple. The caoutchouc is put between two plies of cloth, which it cements so completely, that, when the cloth is not thick, and both plies the same, it would readily be taken for a single ply. For this purpose, two appropriate pieces of cloth are selected, one for the outside, and the other for the lining. These are stretched on tables, or frames, by the common means employed in calico-printing processes. A thin coating of the caoutchouc, in a solution of naphtha, is put on each of them, and is allowed to dry. A second is then put on each and allowed to dry, and likewise, if necessary, a third, and a fourth. At last, a coating is put on one of the plies, and the other ply (with varnished side to varnished side) is put above it, and spread upon it evenly. It is then dried in a stove, to remove the smell of the oil. Lastly, it is smoothed, by passing it through a calender.

This process greatly strengthens the cloth, without materially altering its appearance. The different plies of cloth may be either of the same kind, or different; woollen cloth to woollen cloth; cotton cloth to cotton cloth; silk to silk; woollen cloth to cotton cloth; or, cotton cloth to silk; &c. Woollen cloth, with either a silk or a calico lining, makes an excellent cloak. But of these specimens which we have seen, we admire most those in which both plies are calico. This, we think, makes a light, and an elegant cloak, perfectly water-proof. Indeed, we conceive that the great improvement which this water-proof has introduced, consists in affording complete protection from the inclemencies of the weather, and of situation, by means of a light fabric; but which has hitherto been afforded, only imperfectly, by means of heavy fabrics.

No one, who has ever been at sea, can doubt its usefulness in the dress of sailors, by which they can be supplied with trowsers and coats through which not a drop of moisture can penetrate, and on which the sea may break, and the rain pour in vain.

The same process likewise renders the fabric air-proof. And among the numerous uses to which this property of the fabrics will introduce the process, we may mention bags for holding air, which (in the form of loose shirts) may both enable the sailor, on the emergency of a shipwreck, to reach the shore, and protect him from being bruised against rocks.

Portable military beds, filled with air, were proposed a few years ago; and a late eminent town's-man of our own was of opinion, that beds filled with air might be generally used. Mr. Macintosh's

appears to us excellently ted for this purpose. Not e *Glasgow Mechanics' Ma-* would encourage him that th the hands;" no such An air bed would by no be so soft as a feather bed; ld partake rather of the hard- the mattress, with this dif- , that firmness, rather than ss, would be its characteris- uch beds should have sides and, in the common form of ttress. From the nature of nish employed, we are con- that no vermin would ap- such beds; a circumstance however vulgar the mention nay be esteemed, is a great nendation to the plan, in hot s, and for general use. Air we seriously think, would be more comfortable than either beds or mattresses; and the ement would be very great, ng perhaps equally economi- ey would supersede the use of traw, heather, and the like.

oking at the probable utility . Macintosh's invention, in d many other respects, we that the state of any army red in the field may undergo material improvement, as to provement and health of the provided it were rendered le in this department.

es made water-proof by this , may literally be said never wet; as no water, however they may be exposed, can enetrate farther than the sur-

he contructions of all archi- l works under water, such ges, piers, docks, &c. there be no doubt that the water- l cloth will be almost imme- adopted, instead of the cop- t present employed; being re manageable, and a better e against the water.

Before leaving the subject, we think it proper to point out some uses of this invention less apparent than some of the preceding. Paper may also, by the same process, be made equally water-proof with cloth, leather, &c.; and in this way it will be very much changed in its nature and characters, while its appearance remains nearly the same as before.

Dr. M'Culloch has pointed out, in a series of experiments recently published, that a mixture of any of the essential oils prevents paste, or batter, from moulding; and suggests many advantages resulting from such a discovery where paste is used. For example: in bookbinding, and in cabinets of natural history, in the water-proofing varnish, the naphtha employed will undoubtedly possess the same property, with this important additional advantage, that no moisture, which is the cause of moulding in books bound in leather or paper, can ever penetrate the surface of water-proofed leather or paper. In this branch, the advantages of the invention may be of scarcely calculable extent; as it will secure, in a state of perfect preservation, for ages, books which, in the present state of the art, might be expected, in a short time, to fall a prey to the effects of damp, or to be devoured by the worm or moth.

The only method by which our finest works stand any chance of resisting at present the last mentioned enemy, is, by being bound in Russia leather, the peculiar odour of which seems to be insupportable to them; and the mode of preparing which, is, or was, till very lately, unknown in this country. Now, the slight degree of smell which water-proofed leather acquires in the process, and which is not more disagreeable than that of Russia leather, will, in all probability, render

it an unpalatable food for the moth; and the caoutchouc employed in the preparation of the varnish, will entirely alter leather and paper, as a digestible food for the destructive insects in question.

The linings of carriages, and furniture of cloth and silk, although not exposed to the action of the weather, still, after a short time, moulder into rags, from the ravages of the *Tinea*, or clothes' moth. This process, there can be little doubt, as communicating to them a new property and character, will secure them from the tooth of this insect; so that even where an immediate necessity for the use of water-proofed substance does not appear, an extensive field of usefulness may be opened for the application of the invention.

Drawings or writings made on water-proofed paper, or enclosed in a portfolio made of it, may continue under water, for any length of time, uninjured. Its use, in room of parchment, or the common paper employed for legal purposes, must, for the reasons already stated, be obvious, as it possesses powers of durability far superior to either; and silk, prepared in the same ma affords a surface much better lated for writing upon than ment: and, from no lime being sary to prevent the ink from ru as is the case with parchmen ink will retain its colour to th whilst that used upon vellu parchment, it is well known with difficulty, be prevented decaying.

In concluding this notice, that we have made it much of a discursive nature than first intended. In referring process, we have found ou under considerable embarrass as, though we have every rea be grateful for the liberal com cations which have been ma us, yet, owing to the abse the patentee, we are prev for the present, from procuri specification. On a future oc we shall present this docum our readers, accompanied, if sary, with farther observation

After the details which w given, we need scarcely say we consider the invention ingenious, economical, useful as such, creditable to the inv

THE PRINCIPLES OF NATURAL, OR MECHANICAL PHILOSOPHY.

No. I.

Natural Philosophy may be defined, in its most extended, or unlimited sense, as the knowledge of the laws of nature. It is evident, however, that, when taken in this sense, Natural Philosophy includes every branch of human knowledge, whether as applicable to mind or matter. As we know nothing of the nature of mind in itself, and possess only some questionable facts respecting its laws, the philosopher who wishes to proceed on sure grounds, in the study of generally cuts off all disqui on mind, and, leaving those and idle fancies, that so lo luded the learned world, to t taphysician or moral philos confines himself entirely t study of matter, and its laws.

On the Properties of Bo

Metaphysicians have give different definitions of matter. have even doubted whether

have a moral certainty of our existence. The natural philosopher does not enter into these discussions. Resting uniformly upon experience, he denominates all those bodies *material* which produce a certain assemblage of determinate sensations upon our organs; and the power of exciting in us these different sensations, constitutes for him so many *properties* by which he may recognize the presence of bodies. But, among these properties, two only are essentially necessary to produce in us the sensation of matter; these are *extension* and *impenetrability*, of which the sight and the touch are the first judges.

Extension.

The characteristic drawn from extension is self-evident. When we see, or when we touch a body, this body, or if you will, the power of acting upon our senses which it possesses, resides in certain parts of space and not in others. The place where it resides, is, therefore, determined, and in this even its extension consists.*

Impenetrability.

When we follow the outline or boundary of a body by the touch, we perceive that the matter of which it is composed is external to ourselves. In general, two distinct portions of matter can never be identified with one another, in such a way that the same physical points of space can give us at once the sensation of both. It is in this that its impenetrability consists.

To explain how the union of this property with extension is necessary to the existence of a body, we shall take an example where these properties can be observed separately.

When we place a small object before a concave mirror of polished metal, of which the surface is spherical, it forms, at some distance from the mirror, an image, so much resembling the object, that we can see it very distinctly, if we place it at a proper distance. This image, distinct from the parts of space which immediately surround it, is extended, but not impenetrable. You can plunge your hand into it, without experiencing the least resistance, and the parts which you touch are not displaced, but vanish in proportion. Assuredly, you could not thus penetrate a piece of wood or stone, or any other of those bodies which are called solid. You could even, if you place another mirror in a proper position, cause the image of another object to coincide in the place of this same image, without displacing, or even in any way deranging it.

You could produce the same coincidence with the image of a third object, of a fourth, and as many as you please. All these images are extended, but not impenetrable. They are the *forms*, but not the *palpable matter*; this term is necessary, for we shall see afterwards, that the light which determines those images is, itself, composed of small material particles of an insensible tenuity, which move with an extreme swiftness, and do not dissolve here, but pass through

* The extension of a body in every direction determines the figure of that body; and it may be said, that the figures of bodies admit of an infinite variety. Many, however, present regular and determinate figures, which indicate the action of causes operating according to certain fixed laws. These bodies are called *crystals*, and have a strong analogy to the regular solids contemplated by geometers; which forms they generally take, with various modifications. Extension and figure being the subject of geometry, the student of mechanical philosophy ought to make himself acquainted with the former science, if he is desirous of making any very considerable progress in the latter.

among one another in the spaces by which they are separated.

Here it becomes necessary to notice some very simple phenomena, which seems, at first sight, to contradict the impenetrability of matter, but which, on the contrary, when examined more minutely, do not fail to confirm it.

When we let fall a solid body, for example, a mass of gold, into a fluid such as water, it sinks in it, and seems to penetrate it; but it has, in reality, only caused the separation and displacement of the parts; for, if the vessel which contains the water terminates at the top in a narrow neck, we see the level rise in the neck, in proportion as we increase the volume of the body immersed. There is, in this case, therefore, a division and a separation, but not an intimate penetration of the parts. The same thing takes place when we drive a nail into a plank, or when we cleave wood with an axe; only the parts of these bodies admit of separation with more difficulty than those of water. The same thing occurs, also, if we drive the nail into a mass of clay, of lead, or of gold, in either of which, it only makes its absolute place. Indeed, the mass thus pierced, is not entirely disunited, but its parts are merely pressed and driven back upon one another; and if we take out those parts which surround the hole which the nail has made, we shall find in them sensible traces of this pressure. The nail, in its turn, can be thus pierced by steel, and this, again, can be punctured by other bodies.

This teaches us, that even the hardest and most solid bodies are not composed of matter absolutely continued, but of parts collected together, and placed at distances, which may become greater or less, under the influences of exterior causes. This explains how the same mass of matter increa bulk, by the effect of heat, an tracts by that of cold; ho particles of salts, spread their separation, and are lost, speak, among the particles of how mercury attaches itself gold into which it is thrown insinuates itself even into t terior of the mass; how, in these mixtures sometimes p these solutions without any ent increase of the total bul bulk only extending itself exterior form of bodies, w taking into account the void either sensible or insensible notice, which may be found be their parts. There is, in al therefore, only separation and ture, without penetration of rial parts. *

(To be Continued.)

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* The impenetrability of bod be farther illustrated and confir the following simple experiments

1. A vessel being filled to th with water, if any solid, incap dissolving in that liquid, be into it, a quantity of the wat overflow, equal to the bulk of th immersed.

2. If a cork be thrust hard i neck of a bottle filled with wat bottle will burst, while its neck entire.

In the former case, the w merely displaced, but not pen while, in the latter, it is forced a solid substance, without yiel the compression.

3. Bladders filled with water and placed on a table, will supp large weights, set on a board wh been laid upon them.

The air, though it be comp and, in this respect, unlike wa resists absolute penetration; as obvious from the following exper

4. Take a large vessel nearly fil water, and, on the surface of the place a lighted taper so as to floa out being extinguished; if abo taper a glass tumbler be invert pressed downwards, the contai

LETTERS AND QUERIES.

To the Editor of the
ow MECHANICS' MAGAZINE.

-I am a Mechanic, and beg congratulate you on com- a wörk so much needed, y to be so useful, as a Me- Magazine. It is what has g wanted in Glasgow, and ope, meet with the success es.

engaged in the Machine a Mill, near Glasgow, and ght they would be accept- your work, I would send ounts of several improve- have made in our machines he last five years. I have itten out, and, should you em, will send them in to Vishing you every success,

am, SIR,

Your's respectfully,

A LOOKER-ON.

sss.

annot sufficiently thank our Correspondent, both for his hes respecting our success, handsome offer he has made, is accounts of his improve- machinery. We beg to m that his communications highly acceptable; and we doubt but they will be table for our Magazine. glad, indeed, to find that rtaking has every prospect ss, from the contributions d able and liberal Corre- s; and we trust that their will daily increase, to the th of the city in which we dwell, and the happy and enlight- ened country in which Providence has kindly cast our lot.

There cannot exist a more eno- bling desire in the mind of man than that of communicating knowledge to one another, without any other view than that of instructing the ignorant, and adding our mite to the great mass of science, which already confers an honour upon our race. Nor, on the other hand, can there be a more reprehensible feel- ing than that which leads an indi- vidual to keep up from the sight of his fellow-creatures any discovery or invention, which he is conscious would be of infinite advantage to them, merely because it is his own, or because he expects to reap some advantage from it, which perhaps he may never realize. Knowledge is the common property of mankind, and every one who adds to it a single item which was unknown before, must be considered as a benefactor to his species.

its place, the middle of the l descend, while the rest will the sides, and the taper will r some seconds, to burn, al- olly encompassed by the liquid. re may, indeed, be increased ent; but it will never cause olly to disappear, although it ntracted into a smaller space.

MR. EDITOR,—It gives me great pleasure to see a MECHANICS' MAGAZINE established in Glasgow. I think such a publication was much wanted. At the outset, I would beg leave to advise your Correspondents to give their com- munications in as few words as possible;—it serves no good pur- pose to take up paper and print with *long preambles* and *conclu- sions*. This made me dislike the London Mechanics' Magazine.

I am a working Mechanic, and have for some years kept a small book, in which I occasionally mark down whatever appears to me to be useful or curious, and also ques- tions, to which I cannot give, or get satisfactory answers. From among my yet unanswered ques- tions I send you the following, and

shall be very much gratified by receiving, through your Magazine, a satisfactory solution, to any, or all of them, by some of your more learned Correspondents.

1. Why does the sun, shining strongly on a common fire, extinguish it?

2. Why does thunder, or lightning, spoil beer, porter, milk, &c.

3. When a straight edge is set level, at *any height*, upon land, why does it point exactly to the surface of the sea (if in sight of the sea)?

I once heard a respectable Millwright very earnestly endeavouring to prove to his neighbour, from this last, that the sea is fully as high as any land.

SIR, your's respectfully,
AN OBSERVER.

Tradeston, Jan. 6, 1824.

We join in the request of our Correspondent, and shall be glad to receive solutions of the foregoing questions for the satisfaction of our readers.

Mr. EDITOR,—Perhaps some of your ingenious Correspondents can furnish answers to the following queries:—

1. Is it true that Loch Ness never freezes?

2. If true, why does not Loch Ness freeze? P.

MISCELLANIES.

Mechanism applicable to Instruments for measuring Time, named a Vertical Regulator, or Regulateur a Tourbillon.

BY M. BREGUET.

[From Description des Brevets d' Invention.]

THIS regulator may be adapted to every possible kind of escapement, on which it will uniformly produce its peculiar effect. This effect tends to correct all the anomalies due to the changes of position, of what nature soever they may be; for all the pieces to which the anomalies are due, passing in the space of every minute through all possible positions, a compensation necessarily takes place and annuls the errors.

The machinery being so arranged, that the frame which carries the moveable system shall make one turn in a minute, it is possible to make the axis of this frame carry the seconds' hand.

The peculiar and distinguishing character of this invention essentially consists in this;—the case of the watch being supposed fixed, the balance has, besides its oscillations, or its motions backwards and forwards, (occasioned by the action of the impulsion-wheel, and elastic force of the spiral-spring,) a continued rotary motion round a fixed axis, in respect to the case, proceeding from the moving power; so that the commencement of the oscillation of the balance is found at a given instant; noon, for example, to correspond with a certain point of the circumference of the fixed case; at one second, two seconds, &c. past noon, the commencement of the oscillations will correspond with the different points. This is the principle of the compensations which the author wished to obtain.

A Machine for rendering the Variations of Temperature useful as a Moving Power.

BY M. WOISARD.

[From Memoirs of the Society of Metz.]

THIS machine is composed of two vessels communicating by a vertical tube. The lower vessel is immersed in water. The upper vessel, exposed to the action of the solar rays, incloses a balloon, made of a flexible material, into which air, with a small quantity of a very expansible liquid, such as ether, has been introduced.

It is obvious, that if the atmospheric temperature falls, the balloon will diminish in bulk, the air surrounding it will become rarer, and the water will introduce itself into the lower vessels through a valve. If the temperature rises, the pressure exerted within the machine, by the increase of volume of the balloon, will cause the excess of water to flow out.

rding to the calculation of M. d, if sulphuric-ether be employed, parts of the machine be of suita- ortions, it will raise to the height metre, as many times 500 littres 14 English cubic inches), as there ic metres in the capacity of the essel, whenever the temperature rom 15 to 35 degrees of the cen- thermometer, or from 59 to 77 of Fahrenheit.*

GENERAL WOLFE.

ecdote is told of General Wolfe, e was out with a party of friends at, the day before the battle of Quebec. It was a beautiful summer's evening, and the conversation turned to Gray's *Elegy in a Country Church Yard*, which was just then published. Wolfe repeated the lines—"For who, to dumb forgetfulness a prey," &c. with enthusiasm, and said, "I would rather be the author of these lines than beat the French to-morrow!" He did beat the French, and was killed in the action next day. Perhaps it was more glorious to be capable of uttering a sentiment like this, than to gain a battle, or to write a poem.

NICE CALCULATIONS.

CHEVREAU, in his History of the World, tells us that it was created on the 6th of September, on a Friday, a little after four o'clock in the afternoon. Dean Swift counted the number of steps he took from London to Chelsea. Bishop Wren calculated that he walked round the earth while a prisoner in the tower. In the Preceptor's Assistant we find:—

"*Query.*—What quantity of blood is contained in the human body?

"*Answer.*—Thirty pounds.

"*Query.*—How many bones are there in the human frame?

"*Answer.*—Two hundred and forty-eight."

different ethers are produced by the different acids upon alcohol. Gay-Lus- d the specific gravity of sulphuric ether at the temperature of 56.4 degrees of eit. Under a pressure of 19.92 barom. it boil at 96 F. Placed in contact with closed flask, it at length *undergoes alter-* nd changes in part, according to M. into acetic acid. At the common pres- temperature, water dissolves a tenth part eight of ether. Ether also dissolves a ntity of water. No salifiable base com- h ether, except potash and ammonia. It ith alcohol forming a colourless, clear composable by water, which unites with ol, while the ether rises to the surface bubbles. Ether dissolves oils, resins, rubber. It has but little action upon ther (*æther rectificates*) is principally edicine, as a stimulant, diaphoretic, and odic. It is mentioned as early as 1540. *nard's Analysis*, pp. 94, 287, and 314.

f *Premiums offered by the* SOCIETY OF ARTS, *for the Session* 1823—1824.

Gold Vulcan Medal, or Thirty , for inventing an earthenware to endure greater heat than now in use; and for making or window-glass as transparent e from blue or green colour, as German sheet.

Gold Medal, or Fifty Guineas, for dye for silk or wool, superior to use. For the best mode of stain- ton cloth with a red colour, by ediate application of the colour- ter, and equal to the red colours cured from decoctions of madder. me, of a green colour, equal to urs now formed from decoctions , and solutions of indigo. For of preparing red pigment, fit for oil or water, and equal in tone lliancy to the best lake and carmine. For publishing the best mineralogical and geological map of any country in the United Kingdom, on a scale of not less than one inch to a mile. And for publishing an accurate similar map of Ireland, on a scale of not less than five miles to an inch.

The Gold Medal, or One Hundred Guineas, for the best substitute for the basis of white paint, equally proper as the white lead now employed. For the best substitute for Stockholm tar, equal to the best of that kind, and the produce of Great Britain and the colonies. And for discovering, within Great Britain or Ireland, a quarry of White Marble, equally fit for the purposes of statuary as that imported from Italy.

(To be Continued.)

List of Patents for Inventions, &c. 1824.

John Slater, of Saddleworth, Yorkshire, Clothier; for certain improvements in the machinery or apparatus to facilitate or improve the operation of cutting or grinding wool or cotton from off the surfaces of woollen clothes, kerseymeres, cotton cloths, or mixtures of the said substances; and for taking or removing hair or fur from skins.—*Dated November* 22, 1823.

Thomas Todd, of Swansea, South Wales, Organ-Builder; for an improvement in producing tone upon musical instruments of various descriptions.—*Dated November* 22, 1823.

George Minshaw Glascott, of Garden-Street, Whitechapel, Midd Brass-Founder, and Tobias Mich Upper Thames-Street, London, G for certain improvements in the struction or form of nails to be us or for the securing of, copper and sheathing on ships, and for other poses.—*Dated December* 9, 1823.

Josiah Parkes, of Manchester, cashire, Civil Engineer; for a c method of manufacturing salt.— *December* 4, 1823.

(To be Continued.)

NOTICES TO CORRESPONDENTS.

We would thank the person who favoured us with the Drawing of the L house on the Broomielaw Quay, if he would transmit some account of it to ac pany the Drawing for one of our Numbers.

We would thank N. D. to call at the Publisher's, for we think he has om something very essential in his communication.

D. N., Chemist, would oblige us by sending a note of the authority from w his useful communication was taken, as we recollect having seen it, but have fo ten where.

D. will be inserted in our next, and, we trust, he will continue to favour us such useful articles.

We have not yet received any very satisfactory answers to the queries pro in our last. One Correspondent tells us that the best way to prevent the oil collecting in a lamp is to use gas. Another thinks the query respecting the fo tin reflectors not sufficiently definite, and requires the extent of the room, as w the height of the lamp. We shall take the liberty of limiting the question on b of our Correspondent, though we think a general solution would be better. the room be 15 feet square, and suppose the lamp suspended in the centre 6 feet the floor.

We have been considerably amused by the discussion to which, we understan Bank Interest question has given rise. Many, who at first thought it per simple, are now ready to admit, that it requires consideration. Some think, Bankers neither gain nor lose; others think they lose; and a few are of opi that they gain. Arithmeticians! settle the question, and we shall abide by decision. We have not yet received a clear explanation, although we have solutions lying before us. We would thank our Correspondents to reply to questions so satisfactorily as to set them at rest, lest they accumulate upon our h

We hope that 'A Looker-on' will not forget us.

We trust that D. D. will continue to favour us with similar communication

Communications from intelligent Mechanics will be very acceptable, in wha style they may be written, if they contain a full account of the invention or provement which is the subject of their notice.

SECOND EDITION.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to w Communications (post paid) must be addressed.
Sold by every Bookseller and Newsvender in the Kingdom.
J. CURLL, PRI

THE GLASGOW
MECHANICS' MAGAZINE.

> "The bell strikes one. We take no note of time
> But from its loss. To give it then a tongue
> Were wise in man."—*Young.*

No. III. *Saturday,* 17*th January,* 1824. Price 3*d.*

MR. PATTISON'S IMPROVED CLOCK.

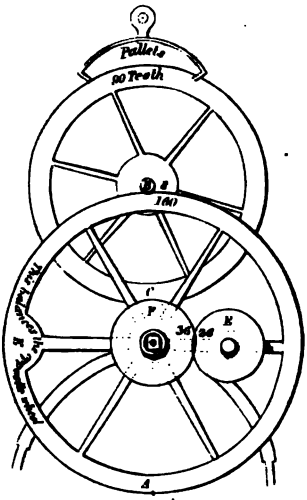

Fig. 2nd

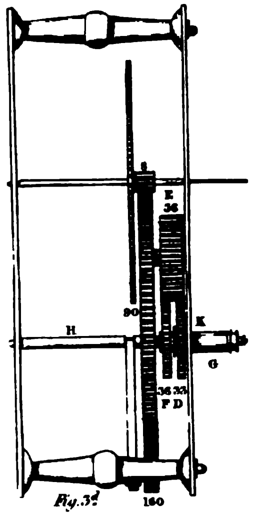

Fig. 3d

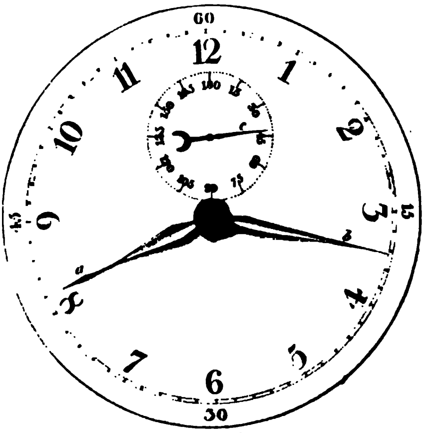

Fig. 1st

MR. PATTISON'S IMPROVED CLOCK.

[*Communicated by the Inventor.*]

This Engraving exhibits the several parts of a Clock, which shows the Hours, Minutes, and Seconds, on a more improved plan than either Franklin's or Fergusson's. Invented by JOHN PATTISON, Glasgow.

"THE dial plate of this clock is represented by Fig. 1. The hours are marked as in a common clock, and the indexes *a* and *b* point out the hours and minutes in the usual way. The circle for the seconds is necessarily divided into 180 parts, which cannot be a material inconvenience to the person who uses the clock.—Fig. 2. shows a front view of the wheel-work of this clock. A is the first, or great wheel, which contains 160 teeth, and goes round in one hour; the index *b* (Fig. 1.) is put on its axis, and is moved round in the same time, which points out the minutes. The hole in the index is round; but it is fastened tight on the round end of the axis, and kept so by a washer and pin; but so as to set, at pleasure, to any point on the dial, without affecting the wheel-work. This wheel of 160 teeth turns a pinion, B, of 8 leaves; and as 8 is the twentieth part of 160, the pinion makes 20 revolutions in one hour. On the axis of this pinion is fixed the scapement-wheel, C, of 90 teeth; which vibrates seconds with the usual length of pendulum, making 180 vibrations, or seconds, in one revolution: which, multiplied by 20, gives 3600 seconds in one hour.

"The axis of the scapement-wheel carries round the index, *c*, (Fig. 1.) in the usual way of common clocks.—Fig. 3. presents an edge view of the frame and wheel-work of the clock; and is intended principally to show the three small wheels that move the hour index. D is a wheel of 33 teeth, which may either be screwed fast to the frame, K, or put on a socket, rivetted in the frame, (as here drawn,) with a spring at the back; and a slit locker in the gutter, *i*, so as to keep it firm; but permitting it occasionally to turn round, as is common in the dial-work of clocks. This wheel, D, drives the broad wheel, E, of 36 teeth; which turns round the pivot fixed in the arm of the hour wheel. This wheel, E, again drives another wheel, F, of 36 teeth; which carries out the socket, G, on which the hour index is fixed. The proper revolutions of this last index-hand is produced by the fixed wheel, D, of 33 teeth, being a twelfth part less than the other two, E and F, of 36 teeth.

"On the axis, H, of the great or hour wheel, the pulley or barrel for giving motion to the clock is fixed. If for 30 hours, a line is made to pass over the pulley, as in the common way; but if the clock is wanted to continue going for a longer time, by increasing the width of the barrels, and doubling the pace-pulleys, it may thus be easily obtained, without additional wheels and pinions. Several clocks have been made by the inventor's directions, on this plan; and they perform uncommonly well, with very little weight, indeed not more than 20 ounces to those of 30 hours, hung in the common way."

The inventor submits the foregoing to the public, as a very simple mode of constructing a clock, and one which a handy mechanic could easily make for himself; besides, if once it were made, it could be very easily kept in order, as the most ignorant person could take it to pieces, clean it, and put it up again, with no expense, and very little trouble. We would, however, sug-

gest one improvement, which occurred to us on the perusal of his description. We think that the broad wheel, E, could not be made to work delicately or correctly into the other two wheels, D and F, because the number of teeth in both is not the same; hence, the teeth must be thicker, or the spaces greater in the one than in the other: we would therefore suggest, that two wheels of 36 teeth, be made to correspond to the two different wheels, D and F, and then fastened firmly together, so as to make but one wheel equivalent to the broad wheel, E. Perhaps other improvements may occur to some of our readers, which we shall be glad they will communicate to us. For the sake of those who are not much acquainted with this subject, we insert the following notice respecting the construction of the clocks to which our Correspondent has referred.

Dr. Franklin contrived his clock to show the hours, minutes, and seconds, with only three wheels and two pinions in the whole movement. The dial-plate had the hours engraven on it, in spiral spaces, along two diameters of a circle, containing four times 60 minutes. The index goes round in four hours, and points out the minutes from any hour which it has passed to the next following hour. The small hand, in arch at top, goes round once in a minute, and shows the seconds. The clock is wound up by a line going over a pulley, on the axis of the great wheel, like a common thirty-hour clock. Many of these very simple machines have since been constructed, that measure time exceedingly well. This clock is subject, however, to the inconvenience of requiring frequent winding up, by raising the weight, as also, to some uncertainty as to the particular hour shown by the index.

Mr. Fergusson proposed to remedy these inconveniences by another construction, which is described in his *Select Exercises.* His clock will go a week without winding, and always shows the precise hour; but, as he acknowledges, it has two disadvantages which do not belong to Dr. Franklin's clock. When the minute hand is adjusted, the hour plate must also be set right by means of a pin; and the smallness of the teeth in the pendulum wheel will cause the pendulum ball to describe but small arcs in its vibrations; and, therefore, the momentum of the ball will be less, and the times of the vibrations will be more affected by any unequal impulse of the pendulum wheel on the pallets. Besides, the weight of the flat ring, on which the seconds are engraven, will load the pivots of the axis of the pendulum wheel, with a great deal of friction, which ought, by all possible means, to be avoided. To remedy this inconvenience, the seconds plate might be omitted.

Mr. Fergusson also contrived a clock, showing the apparent diurnal motions of the sun and moon, the age and phases of the moon, with the time of her coming to the meridian, and the times of high and low water; all this being added to the clock, by having only two wheels and a pinion added to the common movement. In this clock, the figure of the sun serves as an hour-index, by going round the dial in 24 hours; and a figure of the moon goes round in 24 hours, $50\frac{1}{2}$ minutes, the period of her revolution in the heavens, from any meridian, to the same meridian again. A clock of this kind was adapted by Mr. F. to the movement of an old watch. He also gives, in the same work, a description and drawing of an astronomical clock, showing the apparent

sition of strata, landed proprietors have often remained unacquainted with that wealth which lay within their reach. Thus, an estate in Derbyshire was lately sold, which has since been found to contain one of the richest lead mines in the world; and, in the same county, the valuable ores of zinc were for a long period employed in mending the public roads."

He afterwards glanced at the antediluvian period of the globe, and detailed many highly interesting facts connected with that era. The portion of the earth now inhabited, was at one period covered by the ocean; and, by a natural consequence, he inferred, that the portion now covered by the waters was formerly dry land. In support of the former fact, he mentioned some very singular circumstances. Marine productions have been found on Mount Perdu, in the Pyrenees, at the height of 10,500 feet; also, on the Andes, at an elevation of 14,000 feet, and along the whole tract of the Appenines. On this subject he made the following beautiful reflections:

"This inquiry carries us back to the infancy of our planet, when chaos and darkness brooded over all, and our continents and loftiest mountains were still covered by the waters. We can call up the idea of that period—those days of solitude and desolation, when nature was the prey of contending elements, and we can imagine the dreary intervals of repose, with which such disturbed periods were succeeded, when all was one vast solitude—one lifeless desert, in which the voice of no creature was heard; when the polypi, and the imperfectly organized products of the ocean, were the only living inhabitants of the globe. From that, we pass to a later period, when continents began to rise, and their exposed surfaces to be covered with the first verdure of vegetation, and with the primeval forests of these early ages,—when the deep silence of nature was first broken by the voice of the majestic Mastodon, and the nightly Mammoth, which, for a season, were lords of all, but at length perished in the great revolution which preceded the creation of our race."

After detailing many singular facts, Mr. M'Fadyen gave a sketch of the influence of time upon the face of the earth. In the course of ages, the mountains wear away, and at one period must have been much loftier than they are at present. The Pyrenees are said to lose a foot in a century. He then illustrated generally, the slow but sure progress which the ocean is constantly making in altering the face of the globe. The next subject at which he glanced, was a rapid outline of volcanos and earthquakes. This part of the lecture was written with great spirit and elegance; but perhaps the best of the whole, was what related to coral islands. We could not have thought it practicable to render such a subject so highly interesting. The conclusion of the lecture, was occupied in alluding to the various races of animals which have disappeared from the earth, and in giving a general survey of the utility of the science to all classes of society.

We are thus particular in speaking of this introductory lecture, because we consider it far, very far, above the ordinary run of such productions, and an earnest of what the remainder of the course may be. A merely scientific man could not have written it. It contains more than science, and was full of the eloquence of feeling. It occupied one hour and twenty minutes, in the delivery; and the frequent applause which

awaited it throughout, showed the interest it excited in the minds of the Mechanics. The only fault we found was in the lecturer's voice, which is apt to become harsh and grating when it is exerted. Had it been more flexible and energetic, the lecture must have produced a most powerful impression. Let us, however, be thankful for what we have obtained. It is too much to expect in one individual every perfection; and such a piece of composition must have gratified, however delivered. We only speak comparatively; for Mr. M'Fadyen's delivery is far from being absolutely bad. It is only when contrasted with the matter he delivered, that we could have wished it better. His voice is sufficiently extensive, and he may be heard distinctly from the remotest parts of the Hall. Under his management, we have no doubt that this seductive science will rapidly make its way among the Mechanics who attend the Institution; and, while Chemistry unfolds to them one of the fields of natural science, we are sure they will gladly seize upon this opportunity of exploring another, not less beautiful or attractive.

THE PRINCIPLES OF NATURAL, OR MECHANICAL PHILOSOPHY.

No. II.

Porosity.

This discontinuity of matter in bodies, is generally designated by the name of *porosity;* and the interstices which separate their particles are called *pores.* *Porosity* appears to be a general property, and common to all bodies which nature presents to us, although it may not be inherent in the essence of matter; because we can conceive of bodies, perceptible to the senses, where it might not exist.*

Divisibility.

While we thus agree to consider the masses of natural bodies as com-

* The porosity of wood is so remarkable, that air may be transmitted in a profuse stream, by blowing with the mouth through a cylindric piece of dry oak, beech, elm, or birch, about two feet long. If a piece of wood or stone be put in water, and placed in the receiver of an air pump, by withdrawing the external air, the air which has been scattered through the pores of these bodies will issue from every point of their surface, and rise in a torrent of bubbles. In like manner, mercury is forced through a piece of dry wood, and made to fall in the form of a shower.

If a few ounces of mercury be tied in a bag of sheep-skin, it may be squeezed through the leather, by the pressure of the hand, in numerous minute streamlets. This experiment illustrates the porosity of the human skin. From microscopic observations, it has been computed, that the skin is perforated by a thousand holes in a square inch. If the whole surface of the human body be estimated at sixteen square feet, it must contain no fewer than 2,304,000 pores. A compact substance, however, will sometimes prevent the passage of a thin fluid through it, while it gives free passage to a gross one. A cask which holds water will permit oil to ooze through it; and an air-tight bladder will, when immersed in water, imbibe a considerable quantity of it. A cork completely prevents the escape of a liquid through a bottle, while a wooden stopper, which is more compact, would only form a passage for the whole. Mercury can be carried in a small cambric bag, which could not retain water for a moment. Transparent substances, which easily transmit the rays of light, evince extreme porosity. Air itself, however, does not transmit all

posed of very small parts, which constitute their essence, we may inquire what is the form and the magnitude of these parts. It appears that this magnitude is extremely small. Whatever division, for example, we may cause gold to undergo, by drawing, spinning, or gilding, the smallest particles always preserve all the properties which belong to the whole mass. Crystalised bodies, reduced to almost impalpable dust, being examined with a microscope, still exhibit the same forms and the same angles which characterized the entire mass of the chrystal. We have examples of a still greater division in odours, which are only the sensations produced by the invisible and impalpable particles of odorous bodies. All this convinces us, that a body, without changing its nature, and without ceasing to be identical with the largest masses, can be thus divided into parts, whose smallness escapes our senses and almost our imagination.*

Metaphysicians, and even natural philosophers, have had many

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the rays of light; nor will the densest metal absolutely bar all passage to them. The atmosphere is reckoned to transmit, according to its comparative clearness, only from 4-5ths to 3-4ths of the perpendicular light, hence it absorbs from 1-5th to 1-4th of the whole. This is the reason why the sun when near the horizon, yields so much less light than when on the meridian, because its rays have to traverse a much greater portion of the atmosphere.

* The actual subdivision of bodies has, in many cases, been carried to a very great extent. A slip of ivory, one inch in length, may be divided into a hundred equal parts, which are distinctly visible. By the application of a fine screw, 5000 equi-distant lines can be traced in the space of one-fourth of an inch, on a surface of steel or glass, with the point of a diamond. A single pound of cotton has been spun into a thread 76 miles in length; and a pound of wool, into one of 95 miles: the diameters of those threads being only the 350th and the 400th parts of an inch. The ductility of some metals, however, exceeds that of most substances. That of gold will be obvious, from the article on the manufacturing of gold wire, in the present Number.

It has been asserted, that wires, of pure gold, can be drawn of only the 4000th part of an inch in diameter. Dr. Wollaston has advanced much farther: taking a cylinder of silver, about one-third part of an inch in diameter, he drilled a fine hole in its axis, and inserted a wire of platinum only 1-100th part of an inch thick. This silver mould was now drawn through the successive holes of a steel plate, till its diameter was brought to near the 1500th part of an inch, and the internal wire being diminished to the same proportion, was reduced to about the 5000th part of an inch. The compound wire was then dipped in warm nitric acid, which dissolved the silver, and left its core, the wire of platinum. By passing it through a greater number of holes, still finer were obtained; some of them being only the 30,000th part of an inch in diameter. The tenacity of the metal, before reaching that limit, was such, that a platinum wire of the 18,000th part of an inch in diameter, supported the weight of $1\frac{1}{3}$ grains. Such excessive fineness is scarcely surpassed by the finest of nature's threads. Human hair varies in thickness from the 250th to the 600th part of an inch. The fibre of the coarsest wool is about the 500th part of an inch in diameter, and that of the finest, only the 1500th part. The silk line, as spun by the worm, is about the 5000th part of an inch thick; but a spider's line is about six times finer, or only the 30,000th part of an inch in diameter; so that a single pound of this attenuated substance might be sufficient to encompass our globe.

So fine is the sand on the plains of Arabia, that it is sometimes carried 300 miles over the Mediterranean, by the sweeping and violent sirocco. Along the shores of that sea, the rocks are covered by a soft shell-worm, which, by unwearied perseverance, works a cylindrical hole into the heart of the hardest stone. The marble steps of the great

discussions among them, whether this divisibility of matter be or be not possible to infinity. This is a pure question of words. If we mean a divisibility abstract and geometrical, there can be no doubt that it extends to infinity; for, however indefinitely small we suppose a particle to be, yet we can always conceive its extension divided into two halves, every one of these into two others, and so on to infinity. But if we mean a divisibility real and physical, we can pronounce nothing absolute respecting it.

It appears, nevertheless, by the results of experience, that on our globe material particles do not break, neither alter, nor undergo any transmutation amongst one another; for, whatever chemical operation we cause them to undergo, and whatever be the combinations to which we subject them, they always reappear, with their original properties. The infinite variety of actions of this kind which have taken place upon them since the world existed, appears to have produced an alteration in their properties.

Attraction and Repulsion.

But how could a like system of particles exist, when collected in the form of solid and resisting masses, as we see that the greater number of bodies are, even all, when they are properly submitted to experiment? We shall see afterwards, that this state is produced and maintained by the natural forces with which all the particles of bodies are animated, and which makes them mutually tend towards each other, as by *attraction*. But if these forces existed alone, the particles would approach until they were in contact; that is, until they were stopt by the impenetrability of their parts; which is contrary to that possibility of separation and approximation which they preserve in those bodies. Besides, we find that a general cause of interior repulsion exists, by which all the attractive forces are continually balanced. This cause, which resides in all natural bodies, appears to be produced by the principle of heat.

The particles of every body, solicited at the same time by two contrary kinds of forces, are naturally placed in a state of equilibrium, which results from their operations being counterbalanced, and they approach or recede, according as the exterior forces to which they are exposed, favour the attraction or repulsion. It is thus that the bodies which compose our planetary system move and oscillate continually, in the variable ellipticities of their orbits, without which the general equilibrium would be destroyed, and the system itself would fall to ruin. From the different states of the equilibrium of bodies, result, as we shall see, in order, all the secondary and variable properties, such as *the aeriform or gaseous state, liquidity, solidity, crystallization, hardness, elasticity, &c.*

Inertia.

In all these phenomena, the material particles act as so many mas-

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churches in Italy are worn by the incessant crawling of abject devotees; and the hands and feet of bronze statues are in the lapse of ages, washed away by the kisses of innumerable pilgrims that resort to their shrines. What an evanescent particle must be rubbed away at each successive contact!

The diffusion of odours is well known. A single grain of musk has been known to perfume a large room for the space of 20 years. How often, during that time, must the air of the room have been renewed and changed with fresh odours! At the lowest computation, the grain of musk must have been subdivided into 320 quadrillions of particles, each capable of affecting the olfactory organs.

ses absolutely *inert;* that is, deprived of every kind of will. They can be put in motion, displaced, and arrested in their motion, by exterior causes, foreign to themselves. But we can never discover any trace of proper and free volition. If the ball which rolls on the cloth of the billiard-table, by virtue of the impulse which we have given it, abates, by little and little, the quickness of its motion, and finally stops, it is uniformly the effect of the continual resistance that the roughness of the cloth, on which it rubs, opposes to it, and the particles of the air through which it moves. Make the cloth smoother, and the same impulse will move the ball for a longer time. Substitute for it a plane of polished marble, and sides formed by metallic wires, whose elasticity is more perfect, and the duration of the motion will become incomparably greater; which indicates, that it would become indefinite, if the obstacles were entirely removed.

The stone which we throw from the top of a tower, and which, solicited at the same time by this impulse, and by gravity, falls at a certain distance, diminishes, in its progress, its horizontal quickness in imparting it to the particles of air, against which it strikes, and throwing them back upon one another. But conceive that this air did not exist, and that the force of the impulse was sufficiently strong to send the stone to a great distance, by its tangential motion, while gravity tends to make it descend at every instant, the stone would then describe a circle around the earth; and, as nothing would stop it in its course, it would circulate for ever in this manner. This effect reaches even to the moon, which, we know, moves in the void space around the earth; and we see that it equally perpetuates the motions of the other planetary bodies, which run, in the same manner, through a space destitute of all resisting matter.

All this leads us thus to believe, that matter cannot, by itself, either give or take away motion or rest; and that when once it is in one of these states it will persevere in it for ever, if no foreign cause should come to act upon it. This indifference, this want of will, has received the appellation of *inertia.* A single class of bodies seems to form an exception to this; namely, those beings which are called animated, which move or remain at rest by the effect of an interior volition. But even in these, also, the material particles which compose their parts, and even the parts themselves, are absolutely inert. It is their aggregate which possesses the quality of being animated. If they are separated, they live no more, and return to the ordinary laws of all other bodies.

We are in absolute obscurity respecting the cause of this difference, and we are completely ignorant of that which constitutes the state of life; but, seeing in all other circumstances matter destitute of spontaneity, and recognizing that, even in living beings, it also loses this faculty by death and by sleep, we are led to consider it as foreign to its essence, and reducing this case to the ordinary laws, we conceive the will of animated beings as the act of an interior and immaterial principle which resides in them. Indeed, we cannot say in which of their parts this principle resides; neither in what it consists, and still less how, being immaterial, it can act upon matter; but if we have reflected ever so little upon ourselves, and have observed with any attention the works of Nature, these obscurities, (unfortunately too common), in which the imperfection of our knowledge leaves us, ought never to be on our

part the foundation of an objection against the existence of those things, of which we are always destined to be ignorant. We act thus philosophically in this circumstance, as in every other, in bringing analogy to bear upon it, and in making the motion of animated bodies depend on a cause foreign to their matter, since we find matter inert in all the other cases where we can submit it to experiment.

They bring forward, in the schools of philosophy, another reason for attributing spontaneity to an immaterial principle; it is, that the will, by the very nature of its actions, can only emanate from a simple being, and, consequently, cannot belong to a being essentially compound, or, at least, divisible and decomposable, like matter; but this metaphysical reason not falling in with our ordinary considerations, we confine ourselves to the mere mention of it. For all experimental researches it will suffice us to admit the immateriality of the principle of the will, as a distinction founded on analogy, and the *inertia* of matter as a general property in the actual state of the universe.

(To be Continued.)

LETTERS AND QUERIES.

INTEREST QUESTION.

To the Editor of the
GLASGOW MECHANICS' MAGAZINE.

SIR,—Your question concerning bank interest, which is given in the First Number of your likely-to-be valuable Magazine, is certainly somewhat complex, and, to understand properly, "requires consideration." I have been induced to think a little about it, by the complaint you have made in your Correspondents' notices of last Number, and I now beg leave to trouble you with the result of my inquiries.

Some of your Correspondents appear to be led into error, by supposing that what is called simple interest, and bank discount, are the same. They are, however, very different.

When a banker is said to discount bills at £5 per cent., he gives £95 for stamps to the amount of £100. In this case, the rate of interest which he demands for the loan of his money is £5 5 $3\frac{3}{19}$ per cent., for as £95 : £5 : : £100 : £5 5 $3\frac{3}{19}$. Now, when the banker takes 5 per cent. for his discounts, he gives 4 per cent. for his deposits; therefore, £4 taken from £5 5 $3\frac{3}{19}$, leaves £1 5 $3\frac{3}{19}$ per cent. for the banker's profit, in turning the money.

Again, when he announces that he will discount at £4 per cent., he gives at the rate of £96 for £100 in bills. Here the rate of interest is £4 3 4 per cent. (for as £96 : £4 : : £100 : £4 3 4) and £3 being given for the deposit, the sum of £1 3 4 only remains to remunerate the banker, which is less than his 5 per cent. profit by 1*s*. 11*d*. $\frac{3}{19}$; consequently, by the late reduction of interest, the bankers lose one shilling and elevenpence, and three-nineteenths, on every £100 which they keep in circulation.

I am, Sir, your's,

λ.

Anderston, 15th Jan. 1824.

We think the foregoing solution completely settles the bank interest question, and clearly shows that the bankers lose in every view of the case. We have received solutions from J. W.—W. G. J.—C. L.—and K.—all of which proceed on the erroneous principle mentioned by our Correspondent. We thank them sincerely, however, for the trouble they have taken, and trust

they will be as much satisfied with the above solution as we are.

EFFECTS OF VINEGAR.

Sir,—Thinking that the following query comes within the range of your work, I take the liberty of submitting it to your solution.

I lately saw a bone spoon, commonly called an egg-spoon, which had remained in a jug of pickled cabbage for some days, and that part of it which had been immersed in the liquid was much thinner than the other part, and was very much coloured.

Query.—Was the former alteration effected by the natural qualities of the vinegar, or was the liquid adulterated by vitriol or other means?

An Artizan.

Glasgow, 10th Jan. 1824.

The fact mentioned by our querist is new to us; never, in our chemical researches, having examined particularly the composition of an egg-spoon.

Assuming the fact, however, we think that a satisfactory explanation of it may be given, without supposing the vinegar employed in making the pickle to have been adulterated with vitriol.

The chemical constitution of bones is perhaps not so completely discovered, as is desirable. It is known, however, that lime is an essential constituent of bones; in which, indeed, it exists in considerable quantity.

Now, our chemical readers know that vinegar, (when pure,) is just acetic acid, diluted commonly with twenty times its weight of water, and that acetic acid combines with lime, forming the acetate of lime, a salt very easily soluble in water. We think it probable, that such a combination took place on the occasion mentioned by our querist.

As, however, vitriol might have produced the same effect, and as this is an adulteration which is very much suspected, at least, to exist in many preparations, we think it proper to point out a very simple means by which vitriol may be detected, wherever it is suspected to exist.

Either nitrate of lead, or muriate of barytes, must be procured from an apothecary's shop, and the salt dissolved in water. Into a small glass of the liquid suspected to contain vitriol, a few drops of this solution should be put, and, if the liquid really contains vitriol, a precipitate will fall; that is, the liquid will become muddy, and the muddy matter will fall to the bottom. This precipitation is occasioned by the vitriol (also called sulphuric acid,) combining with the lead and the barytes of nitrate of lead, or muriate of barytes, and forming the sulphate of lead, or muriate of barytes; salts, which, being insoluble in water, fall to the bottom. Either of these tests will detect the presence of a very minute quantity of vitriol. As both nitrate of lead and muriate of barytes are poisonous, none of the liquid in which they may be put, must be tasted.

It is proper also to mention, that as the salt formed by vitriol and lime is soluble in water only in a very minute quantity, it is likely that the action of vitriol upon the spoon would be evinced either by a slight precipitation, or by the spoon being roughened.

Glasgow, distinguished in many of its manufactures, stands pre-eminent in the manufacture of vinegar. That which is manufactured by Messrs. Charles Macintosh & Co. from malt, and that by Messrs. Turnbull & Ramsay from wood, is free from all adulteration. Generally speaking, the London vinegars are inferior to those manufactured in Glasgow, and are frequently

ed; though, indeed, we are one attempt in London to ure on the principles adopt- sgow.

ON GILDING.

-If you think the inclosed on worth notice, it is at ice.

g through the streets of ne day, I observed many , which seemed to have years, so much tarnished eather and other causes, as difficult to tell whether s had ever been gilded. cases, however, I noticed e a nail had been accident- n in, and where the rain, rst corroded it, had run pregnated with the ore gilt letters, the brilliancy ld was either preserved or in such a manner, that it as if it had been newly This circumstance sug- me the following query: not corroded iron, or rust e employed, in some way in gilding on wood, so as ve the brilliancy of the ges?

s it only requires a little ion from some able che- termine it.

am, Sir,

Your obedient servant,

N. D.

QUERIES.

If the two following ques- t your approbation, by them in your Magazine, uch oblige

QUIRER AFTER KNOWLEDGE.

t is the best method in put on dash wheels, not he other geering?

at is the most improved whereby to ascertain the ower betwixt the steam side of the piston and the eduction side; whereby the master may know the power required to move the engine at her regular speed, when without the machinery—and likewise the power required for each piece of machinery when put to the engine; so that the master may know when his engine is in the best possible working order?

LOCH NESS.

SIR,—In your Second Number, it is requested to know the cause why Loch Ness does not freeze.

In accidentally glancing over "Mrs. Murray's Guide to the Beauties of Scotland," at page 235, the following answer is given:

"Let a frost be ever so hard, Loch Ness has never been known to freeze; it is therefore imagined, the whole bed of it is of sulphur. The water of the Ness river, and, I believe, most of the water about Inverness, is strongly impregnated with it, and often disagrees with man and beast, particularly with strangers unaccustomed to it. In the spring, 1796, some military men were obliged to be removed from Inverness, many of them having died of the flux, in consequence of the water being so strongly impreg- nated with sulphur."

I intended to have given you some hints of a new plan, concern- ing the proposed improvements at the Broomielaw, but have not time to enter into them properly, at pre- sent; you may, however, expect to hear from me soon on that subject.

Your's, &c. R.

Glasgow, 15th Jan. 1824.

MR. EDITOR,—If any of your ingenious Correspondents can ex- plain, upon *natural* causes, the fol- lowing question, it will oblige,

Sir, your's respectfully,

D. A. N.

Glasgow, 12th Jan. 1824.

Question.—Why was light formed upon the first day of the creation, when the sun, the great primary cause of light, was not formed till the fourth?

SIR,—I would be much obliged by you, or any of your Correspondents, informing me what is the best mode of ventilating churches, or rooms where large companies are accustomed to meet.—I am, Sir,

Your constant reader,

J. C.

An easy Method of rendering assistance to Persons in Danger of Drowning.

THIS desirable object may be attained by the following very simple means, a man's hat and pocket handkerchief being all the apparatus that is necessary. Spread the handkerchief on the ground, and place a hat, with the brim upwards, in the middle of the handkerchief; then tie the handkerchief over the hat as you would do a bundle, keeping the knots as nearly as possible in the centre of the opening. Then by seizing the knots with one hand, and keeping the crown of the hat upwards, any person, though unable to swim, may fearlessly plunge into the water with a rope, or any other thing that may be necessary to save the life of a fellow-creature.

When any person is in danger of drowning, if he had the presence of mind to take off his hat, and hold it by the brim, placing his fingers within side of the hat, and keeping the top downwards, he would be able, by this means, to keep his head above water till assistance should reach him.

By inserting this in your useful Magazine, you will oblige, your's,

PROBUS.

Glasgow, 12th Jan. 1824.

MISCELLANIES.

ON PROCURING LIGHT INSTANTANEOUSLY.

AT a meeting of the Wernerian Society at Edinburgh, a few days ago, a small lump of platinum, which had been reduced to a spongy mass, by having been dissolved in *aqua regia*, precipitated and heated, was placed upon a stand. On applying a pipe, affixed to a bladder containing hydrogen gas, in such a manner that a very fine stream of the gas should be directed upon the spongy mass of platinum, a brilliant and instant flame arose, which continued as long as the gas was supplied. This apparatus appears to be the most simple, the most beautiful, and the most elegant mode of obtaining a sudden light, hitherto invented. It may be so arranged, that upon pulling a string, a light will instantly follow, which will be extinguished as soon as the string is let go. The advantages of such a light, for a chamber at night, are obvious, and it cannot be doubted but that something of this kind will be very soon adopted. It is a little remarkable, that the lightest and heaviest substances known should be brought together in this experiment.

COMPARATIVE NUTRITIVE PROPERTIES OF FOOD.

AN interesting report on this subject has lately been presented to the French minister of the Interior, by Messrs. Percy & Vauquelin, Members of the Institute. The result of their experiments is as follows:—In bread, every 100 lb. is found to contain 80 lb. of nutritious matter; butcher meat, averaging the different sorts, contain only 35 lb. in one hundred; French beans, (in the grain) 92 lb. in one hundred; broad beans, 89 lb., peas, 93 lb., lentils, (a species of half pea, little known in Britain) 94 lb. in one hundred; greens and turnips, which are the most aqueous of all vegetables used in culinary purposes, furnish only 8 lb. of solid nu-

tritious substance in one hundred; carrots, (from whence an inferior kind of sugar is produced,) 14 lb.; and what is remarkable, as being opposed to the old theory, 100 lb. of potatoes only yield 25 lb. of nutriment; one lb. of good bread is equal to $2\frac{1}{2}$ lb. of potatoes; and 75 lb. of bread, and 30 of meat, are equal to 300 of potatoes; $\frac{1}{2}$ lb. of bread, and 5 oz. of meat, are equal to 3 lb. of potatoes; 1 lb. of potatoes, is equal to 4 lb. of cabbage, and 3 lb. of turnips; and 1 lb. of rice bread or French beans, is equal to 3 lb. of potatoes.

D. N., Chemist.

Glasgow, Jan. 2, 1824.

THE COMET.

This unexpected visitor is conspicuous towards the east on bright mornings, from 5 till half-past 6 o'clock; and its motion is retrograde, or contrary to the signs of the zodiac. It has moved out of the constellation Serpentarius, and is advancing rapidly along the back of Hercules, towards the contortion in the body of the Dragon. Its mean motion through, or under, the fixed stars, during the last fortnight, was 1 deg. 40 min. per day. Its present right ascension is 245 degrees, and its declination, 26 deg. 30 min. north. Last Sunday morning, which was remarkably clear, the tail was nearly 5 deg. long, and tapered at the end. Its nucleus* is still undefined, and no larger than a star of the third magnitude; but the coma† around it is very thick, and the coruscations unbroken. The Comet's distance from the sun is about 65 deg. and its motion being from that luminary, it will be seen to have a long range in the heavens; it must, on this account, be interesting to those who are engaged in the study of astronomy.

Gosport Obs. Jan. 1824.

THE GLOW-WORM.

Mr. John Murray, in a communication, recently made to the Royal Society, on the luminous matter of the glow-worm, states some curious facts, as the result of his own observations and experiments. He shows that this light is not connected with the respiration, nor derived from the solar light; that it is not affected by cold, nor by magnetism, nor by submersion in water. When a glow-worm was immersed in carbonic acid gas, it died, shining brilliantly; in hydrogen, it continued to shine, but did not seem to suffer. He infers, that the luminousness is independent, not only of the respiration, but of the volition and vital principle. Some of the luminous matter, obtained in a detached state, was also subjected to various experiments, from which it appears to be a gummo-albuminous substance mixed with muriate of soda, and sulphate of alumine and potash, and to be composed of spherules. The light is supposed to be permanent, its eclipses being caused by the interposition of an opaque medium.

* Body. † Rays like hair.

LIST OF PREMIUMS BY THE SOCIETY OF ARTS.

The Gold Medal, or Fifty Guineas, for a method of purifying whale or seal oil from the glutinous matter that encrusts the wicks of lamps; and for a method of rendering oil more fit for chronometers and watches.

The Gold Medal, or Thirty Guineas, for making flint glass free from veins, and as dense and transparent as the best now in use; and for the best mode of preserving the seeds of plants in a state fit for vegetation.

(To be Continued.)

LIST OF PATENTS.

Samuel Brown, of Windmill-Street, Lambeth, Surrey, Gent.; for an engine or instrument for effecting a vacuum, and thus producing powers, by which water may be raised and machinery put in motion. *Dated December* 4, 1823.

Archibald Buchanan, of Catrine Cotton-Works, partner with James Finlay & Co. Merchants, Glasgow; for an improvement in machinery heretofore employed in spinning-mills in the carding of cotton and other wool, whereby the top cards are regularly striped and kept clean by the operation of the machinery, without the agency of hard labour.—*Dated December* 4, 1823.

Thomas Horne the younger, of Birmingham, Warwickshire, Brass-founder; for certain improvements in the manufacture of rack-pullies, in brass or other metals.—*Dated December* 9, 1823.

William Furnival, of Droitwich, Salt-manufacturer, and Alexander Smith, of

Glasgow, Master-Mariner; for an improved boiler for steam-engines and other purposes.—*Dated December* 9, 1823.

Sir Henry Heathcoate, of 23, Surrey-Street, Strand, Middlesex, Knight, and Captain in the Royal Navy; for an improvement of the stay-sails generally in use, for the purpose of intercepting wind between the square-sails of ships and other square-rigged vessels.—*Dated December* 13, 1823.

(To be Continued.)

CASE OF A MECHANIC.

Mr. James Cross, of Paisley,

The inventor of the new weaving machine for superseding the use of draw-boys, (an invention which, we believe, is destined to work a great revolution in our manufactures,) has been compelled to submit it to public inspection, for the want of proper remuneration. The manufacturers of Paisley have long reaped the benefit of Mr. Cross's other inventions, which are many and important; and though they have published the most flattering reports respecting these inventions, but particularly the present, it is strange that so little should have been done for the inventor. It has been well said, by the writer of the "Account of Mr. Cross's Inventions," a pamphlet which we strongly recommend to the perusal of our readers, that "he was *a public servant, by public appointment, and for a public benefit.*" From this work, it appears that Mr. Cross had, from time to time, been encouraged to go on with his inventions, with the hopes of being renumerated for his trouble and expense, by committees of weavers and manufacturers in Paisley; and now that his invention is reported to be complete, and the utility of it already demonstrated by experience, a period of more than 12 months has elapsed, and nothing satisfactory has been done for him, although he has spent more than his "little all" in the accomplishment of his grand object.

The Honourable the Board of Trustees for the improvement of manufactures in Scotland, have awarded to Mr. Cross, for the invention of his machine, the sum of one hundred guineas, which is a sufficient proof of its very great utility. This sum, however, liberal as it is, is totally inadequate to recompense him for his labours, as we understand that when the expense incurred in fitting up the machine for public use, has been liquidated, little or no surplus will remain for his future support and comfort, although he is now reduced to a state of extreme debility, arising from his unwearied assiduity and limited means of supporting himself and family, during the progress of his inventions. In an early number, we shall take an opportunity of submitting to our readers a drawing and description of this very ingenious machine.

NOTICES TO CORRESPONDENTS.

The solvers of the interest question will find in this Number what we consider a final answer to it, from a Correspondent in Anderston.

We want solutions of all the other questions.

'An Observer' shall have an early insertion.

'A Constant Reader' shall be answered.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement which is the subject of their notice.

To accommodate our Edinburgh Correspondents, their communications (post paid) may be addressed to the Editor, care of Messrs. Edward West and Co. Booksellers, by whom they will be transmitted to the Publisher.

SECOND EDITION.

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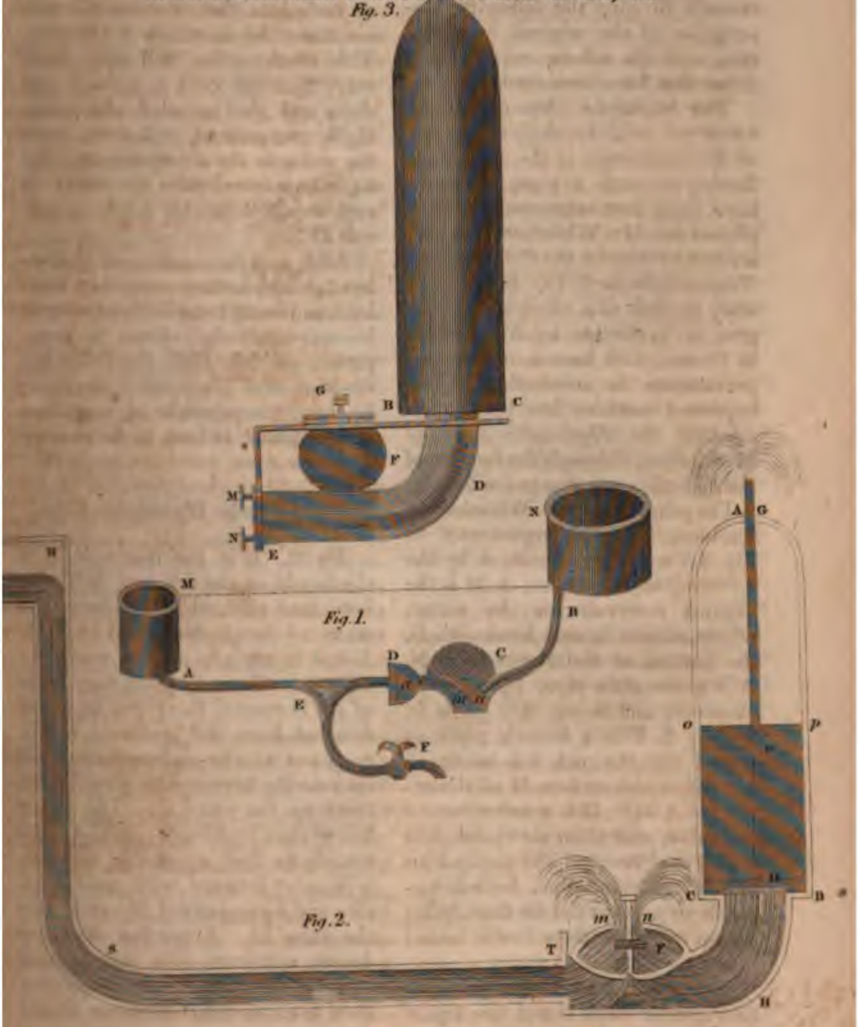
J. CURLL, PRINTER.

THE GLASGOW MECHANICS' MAGAZINE.

" Where dwells the *Light?* In what refulgent dome?
And where has *Darkness* made her dismal home?"—*Young.*

No. IV. *Saturday, 24th January,* 1824. Price 3*d.*.

MONTGOLFIER'S HYDRAULIC RAM, &c.



DESCRIPTION OF HYDRAULIC MACHINES.

Whitehurst's Machine.

We have been induced, from the request of several Correspondents, and from an idea that water might be more generally employed in producing power, (being a much safer and less expensive article than steam,) to give the following description of the original hydraulic ram, with the subsequent improvements that have been made upon it.

The ingenious idea of raising water to great heights, by means of the momentum of the same fluid flowing through a pipe, seems to have been first suggested and employed by Mr. Whitehurst, as described by him in the Philosophical Transactions for 1775. It has been since carried to a considerable degree of perfection by Montgolfier in France, well known for his improvements in aerostation. The improved machine has been denominated the *Hydraulic Ram* of Montgolfier, although the honour of the invention was due to the former.

The principle of Mr. Whitehurst's machine, (which is represented in Fig. 1,) will be understood by the following explanation:—A M is the original reservoir for the water, whose surface is on a level with B, the bottom of the reservoir B N. A E is the main pipe, $1\frac{1}{2}$ inches in diameter, and nearly 200 yards in length; E F is a branch pipe, so placed that the cock F is about 16 feet below the surface M of the reservoir A M. D is a valve box, *a* the valve, and C an air vessel, into which are inserted the extremities *m n* of the main pipe, bent downwards to prevent the air from being driven out when the water is forced into it.

Now, since the difference of level between the cock F and the top of the reservoir A M is 16 feet, on opening the cock, the water will issue with a velocity of 32 feet per second. A column of water, therefore, 200 yards in length, is thus put in motion with a very considerable momentum. Let the cock F now be suddenly stopped, and its momentum will force open the valve *a*, rush into the air vessel C, and condense the air which it contains. This condensation will take place every time the cock is opened and shut, and the included air, being highly compressed, will press upon the water in the air vessel, and, by its elastic force, raise the water to any required height in the reservoir B N.

Such was the machine of Whitehurst, which he first erected in England, and found completely to answer his expectations. From a comparison of this, with the following description of Montgolfier's hydraulic ram, the principle of operation will be found in both to be exactly the same.

Montgolfier's Hydraulic Ram.

Fig. 2. R is the reservoir, R S the height of the fall, and S T the horizontal tube which conducts the water to the machine A B H T C. E and D are two valves, and F G a pipe, reaching within a very little of the bottom C B. Now, let water descend from the reservoir, it will rush out at the aperture *m n*, till its velocity becomes so great as to force up the valve E. The water being thus suddenly checked, and unable to find a passage at *m n*, will move forward with great velocity and force toward H, and raise the valve D. A portion of water being admitted into the vessel A B C, the impulse of the column of fluid is expended, the valves D and E fall, and the water rushes out at

m n as before, when its motion is again stopped, and the same operation repeated which has now been described. Every time, therefore, that the valve E closes, a portion of the water will force its way into the vessel A B C, and condense the air which it contains; for the included air has no communication with the atmosphere, after the water is higher than the bottom of the pipe F G. This condensed air will consequently exert great force on the surface *o p* of the water, and raise it in the tube F G, to a height proportional to the elasticity of the imprisoned air.

The tube S T, through which the water runs, is called the *body of the ram;* the tube F G, through which the water is raised, is called the *tube of ascension;* the two valves, which shut the orifices E and D, are respectively denominated the *stoppage valve*, and the *ascension valve*. These valves are hollow globes of metal, which are placed at E and D, the thickness of the metal being such, that they may not weigh more than double the weight of the water which they displace. The extremity of the body of the ram at D, and the reservoir at E, form together what is called the *head of the ram*. The ascension tube is sometimes placed on the left of the stoppage valve at E, instead of the right as in this figure.

The external appearance of the machine, is exhibited in Fig. 3; where A B C is the air vessel, F the valve box, G the extremity of the valve, and M N screws for fixing the horizontal tube to the machine. A piece of brass A, with a small aperture, is screwed on the top, when the machine is employed, to form a jet of water.

From this description it will be seen, that the only material difference between the machines of Montgolfier and Whitehurst, is, that the one requires a person to turn the cock, while the other has the advantage of acting spontaneously. From Montgolfier's experiments, the effect of the water-ram is between $\frac{1}{2}$ and $\frac{3}{4}$ of the power expended. The principles on which this machine is constructed, are susceptible of very extensive application; particularly in mines, pits, quarries, water-works, &c.

To judge of the utility of any hydraulic machine, we must consider its produce, the expense of its erection, and that of keeping it in repair. Now, in every hydraulic machine, the force expended is the product of the water which comes from its source, multiplied by the height it falls through before it acts on the machine; the produce being the quantity of water raised in the same time, multiplied by the height to which it is elevated. Applying these principles to the hydraulic ram, it appears, from experiments made upon one at the polytechnic school in France, that the expense was to the produce as 100 to 45.

The height of the fall was about six feet, that of the ascending pipe $38\frac{1}{4}$ feet; the tube of the vertical, or active column, was $21\frac{1}{4}$ inches in diameter, being fixed at the bottom of an oval-shaped vessel; the horizontal, or passive column, was also $21\frac{1}{4}$ inches in diameter; the ascending tube of tin, was about $\frac{1}{12}$th of an inch interior diameter, and $38\frac{1}{4}$ feet elevation; the total length about 107 feet. The discharging valve closed from 40 to 42 times per minute, and the water which fell in 10 minutes, was about 30130 cubic inches; that which was raised up the ascending tube in the same time, was about 3161 cubic inches; from which data, the ratio above-mentioned was obtained.

In another hydraulic ram, erected

by Montgolfier in his garden, the fall, which was procured artificially, was $7\frac{1}{2}$ feet; the height to which the water was raised, 50 feet; the diameter of the tubes, 2 inches; the water expended in four minutes, was about 19224 cubic inches; that elevated, about 1831 cubic inches; hence, the expense or force employed, is $19224 \times 7\frac{1}{2} = 144180$; the useful force, $1831 \times 50 = 91550$; which gives the ratio of 100 to 64 nearly.

In another experiment made upon a ram at Avilly, near Senlis, by M. Turquet, bleacher, the expense was found to be to the produce as 100 to 62. In an experiment on a fourth machine, in which the passive column was nearly 34 feet in length, and the height of the ascending pipe nearly seven times that of the head of the water, the discharging valve closed 104 times in a minute, and the expense was to the produce as 100 to 57. Taking the mean of these experiments, the expense will be to the produce as 100 to 57; so that a hydraulic ram, placed in favourable circumstances, and executed with care, may be said to employ usefully, at least half its force.

Improved Hydraulic Ram.

Considerable improvements have been made in the original ram of Montgolfier, by his son, who has taken out a patent for his construction in this country. The operation of his machine is more effective than in that of his father, by about 84 per cent.; at the same time, the length of the tube is considerably less than in the former machine.

These improvements consist, first, in the addition of a small snifting valve, which introduces a quantity of air into the head of the ram, at each movement or elevation of the water; whence it is driven by the next movement into the air vessel, which would otherwise become filled with water under a high pressure. Again, in the interior of the head of the ram is an annular space surrounding the frame of the stop valve; this contains a small volume of air which cannot be forced into the air vessel, but which, at the first instant, is compressed by, and receives the effort of the moving water. This is called the air matrass, which, by means of the stop valve, is shut with less noise; the pipe has a diminished strain thrown upon it, and all the operations take place with so much ease, that the machine is less exposed to be shaken and put out of repair.

Another change in the construction is, that the end of the pipe, or body of the ram, which receives the water of the reservoir, is formed like a trumpet-mouth, that the water may flow more readily into the pipe; the length of the latter being regulated according to the height of the fall of water which is to produce the current through it. The pipe is composed of several pieces, or lengths, screwed together by flanches, or other similar means; but it is in the end piece, which is called the head of the ram, that the moving parts of the machine are placed. The extremity of the pipe, or head of the ram, is a hollow sphere, the diameter of which is nearly twice as great as the bore of this pipe; the upper part of the spherical end is flattened, so as to reduce it to the segment of a sphere, with a flat circular surface on the top or upper side, in the centre of which surface, is a large circular opening to receive and hold the seat of the stop valves, at which the water issues; but when the valve is closed, it prevents the water from issuing.

The water, when the valve opens, descends perpendicularly into the hollow sphere, and leaves a free

passage through the opening. The valve is guided between three or four perpendicular stems, which have hooks formed at the lower ends to retain or support the valve when opened; and these stems are fixed by screws; so that they can be regulated to allow the valve to descend more or less, and to open a greater or less passage for the water. The valve is hollow, having a flat circular plate of metal, with a hollow cup or dish of the same matter attached to its lower surface: this, at the same time, renders the valve lighter in the water, and gives it a convex surface on the lower side, which, when it is opened, corresponds in curvature with the interior concave surface of the spherical end of the head of the ram. The seat of the valve is composed of a short cylinder or pipe, of which the opening is much greater than the transverse section of the body of the ram, and the short cylinder is screwed by its flanch into the opening in the upper surface of the head. The flanch of the seat is so formed as to have an inverted cup round the upper part of the short cylinder; that is, a circular channel or annular space within the head of the ram, which will contain air, and from which the latter cannot escape when the water compresses it.

The air in this channel is called the matrass, and the snifting valve is at the end of a small pipe which leads from the annular space or matrass to the open air. The snifting valve opens inward, in order to admit the air to enter into the matrass; and, to prevent its return, there is another small valve in the same pipe which opens outwards: its office is to admit a certain quantity of air into the matrass, and then to shut and prevent any farther entrance.

On the outside of the seat of the stop valve that is over the aperture in the head of the ram, where the water issues, another stop valve is applied, which is similar to the internal valve before-mentioned, but shuts down on the outside of the seat. The upper part of the pipe, or head of the ram, is made flat at the part near the end, where it enlarges to a sphere; and this flat surface on the top of the pipe has several narrow openings across it, which are covered by as many flap valves of leather, to allow water to pass out from the main pipe, and to prevent its return. And on each side of the head of the ram, at the part opposite these flap valves, is a hollow enlargement, in the form of a segment of a horizontal circle; and the two enlargements taken together form a circular basin, through the centre of which the pipe of the ram passes; but, as before stated, the pipe, instead of being circular, is flat at top at that part, to form the seats for the flap valves. This circular basin is covered by a cylindrical air vessel, screwed down by means of a flanch at the edge, so that the circular basin forms the bottom of this space.

In consequence of this arrangement, all the water which issues from the body of the ram through the flap valves will flow off on each side, and be received in the basin; but as the circular basin, or bottom of the air vessel, is divided into two parts by the pipe of the ram which passes it, there is a passage communicating from one of the enlargements to the other; for which purpose, it curves down, and descends beneath the pipe of the ram; and the ascending pipe that carries away the water which the machine raises, proceeds either from this curved passage, or from some other part of the basin, so that it may receive the water which has passed from the body of the ram through

the flap valves and the air vessel into the basin, at each side of the pipe.

The action of this hydraulic ram is nearly the same as the preceding. Suppose the pipe or body of the ram to be full of water, if the internal stop valve be opened, the water from the reservoir will flow through the body of the ram, and, issuing through the opening at the end, it will lift up the external stop valve and escape; but the current having continued until the water has acquired a certain velocity, the force of the current buoys up the internal valve, and closes the passage. The motion of the water contained in the ram will thus be suddenly arrested, and by its *vis inertia*, or moving force, will exert a sudden pressure against the stop valve, and against all the interior parts of the ram. The small quantity of air contained in the space around the interior stop valve, which is, as we have seen, called the air matrass, is compressed into a smaller space, and, by its elasticity, takes off the violence of the shock, or blow, which would otherwise be produced. This pressure opens the flap valves on the top of the pipe which are within the air vessel, and a portion of the water will be driven into that vessel, which is supposed to be full of air, compressed or condensed, till its elasticity equals the pressure of the column of water which is to be raised up the ascending pipe by the action of the machine.

The air vessel, by thus receiving an influx of water, has the air within it condensed, whereby it enters with a greater elastic force, exceeding the pressure of the column of water in the ascending pipe, and, by degrees, the air will force all the water which was injected through the flap valves, through the said pipe, and cause that quantity of water to issue from the upper extremity of the pipe. The *vis inertia* of the water, which was in motion in the ram, having expended itself by forcing a portion of water into the air vessel, and making a still greater compression of the contained air, a recoil of the water will take place in the body, arising from the re-action or elasticity of the air contained in the air matrass, as likewise of the metal of which the tube is composed. The flap valves within the vessel being now shut, prevent the return of the water which had been forced into the air vessel, and the recoil of the water in the body towards the open end causes a slight aspiration, the external stop valve descends by its weight, and prevents the water with which it is covered from entering through it; but the air passes through the small pipe leading from the open air to the annular space above-mentioned, and opens the snifting valve, by which means, a very small quantity of air enters the matrass.

During the recoil, the internal stop valve, having nothing to sustain it, falls by its own weight and opens the passage; and as soon as the force of the recoil has expended itself in acting against the column of water contained in the reservoir in the body of the machine, the water begins again to flow in its original direction, and repeats the action above described.

ON THE CREATION OF LIGHT.

We have thought proper to attempt a reply to the question in our last, "*Why light was created* on the first day, when the sun, the great primary cause of light, was not created till the fourth?" Our rea-

son is, that it is a question commonly proposed by infidel philosophers, who think, that because this part of the Mosaic account of the creation does not agree with their notions of simplicity and sequency in matters of philosophy, that, therefore, it is not entitled to credit in itself, and that it likewise throws a degree of doubt over the whole scripture history. Before entering upon our conjectures on this subject, we would remind all such philosophers and their followers, that there is a great difference between what is contrary to reason, and what is beyond reason; and that, therefore, in every question of difficult interpretation, it behoves them, before they dare to impugn its validity, to demonstrate, either that it is contrary to reason, or that it is contrary to the nature of things, whether we are able, or not, to conceive of its possibility.

Theologians, in explaining such questions, have, perhaps, generally passed over them too slightly, and thus they may have led their opponents to conclude, that they have fairly given up their validity in philosophy; while others may have, perhaps, deemed it a species of profanity to make them a subject of discussion, from the unwarrantable fear, that the truth might, by such means, be materially injured. We would request such false friends to truth to remember, as a valuable maxim—that truth, whether physical, or moral, never suffers by investigation and discussion; but that, on the contrary, like the gold that is thrown into the furnace, it will come forth from the severest scrutiny, seven times purified.

In stating our conjectures on the present subject of inquiry, it is necessary to advert to the original of all things. "In the beginning, God created the heavens and the earth." In what state did matter exist at this period? "The earth was without form, and void;" or, as the original words signify, it existed in a state of chaos, darkness, and confusion. The Great Being who thus gave existence to matter, in this rude and imperfect state, could have, as easily, commanded the whole system of the universe, harmonious and beautiful as it is, into full and perfect existence in one instant of time. He willed a different mode of procedure. The work of creation was progressive. The whole was reduced to order in six days. The agency employed was the *Word* of God. "He spake, and it was done; he commanded, and it stood fast." He said, "Let light *be*, and light *was*." These representations accord with the mighty *fiat* imagined in antiquity; expressed by Ovid; traced to Moses; applauded by Longinus; and found to coincide with the universal idea among mankind, of a first principle impregnating the chaos, and giving birth to nature.

The first impression made upon matter, by the Creator, was the communication of separate existence to a portion of it, which constituted *light*. This may have taken place by the instantaneous abstraction of the latent particles of light from the whole mass. They might then exist in a fluid state, darting their rays into the infinity of space, and waiting the command of him who called them forth from their obscurity. Indeed, here we can find no difficulty in supposing the pre-existence of light to that of the sun, since He, who dwells in "light that is inaccessible," far other than the rays of the sun which we mortals behold with impunity, could equally disperse this wonderful effect of his power over all created matter, as concentrate it into an innumerable multitude of solid masses, from which its rays might be reflected to

their respective systems. Some have conjectured that the sun was then in existence, but had not yet become visible, either for want of an atmosphere in the earth, in itself, or in both. This seems not to be without foundation, as we know that the atmosphere of our earth was not created till the second day of creation, when the *firmament*, or *expansion*, was made, as the original word signifies. The same invisibility of the sun, however, would have been the result of the non-existence of its atmosphere, as we have almost presumptive evidence, from the phenomena of solar spots, that the body of the sun is opaque; these spots being supposed to be cavities in it, through which the dark matter of the sun is observed.

The creation of this atmosphere of light around the sun, on the fourth day, will amount to an explanation of the question, while it would be absurd to suppose that light could exist no where but in the sun, when He who formed it, on the first day of the creation, was *present* at the gradual accomplishment of his "handy-work." Objectors will, no doubt, be ready to call in question the propriety of attributing so much importance to the earth, as to suppose that the sun, a globe of such magnitude, that it is one million three hundred thousand times greater than our globe, was formed in this way, solely for her use; while so many planets, some of whom are a thousand times greater than it, are all equally dependent upon the sun for the light and heat which they enjoy. It is not necessary, however, to suppose that the earth alone was formed at the beginning of the world; the other planets may have been created at the same time, and may have been subjected to a similar mode of procedure at their creation. Moses does not profess to give a history of the universe, but merely an account of the creation of the world. On the fourth day, the sun and the moon were created; which are described by the historian, according to their visible appearance, as "the greater and the lesser lights;" his language being accommodated to the popular sense, rather than confined to philosophical precision; the moon, although much less than the sun, approaching so near us, appears of almost equal magnitude; and though far inferior in dimensions to those heavenly and distant bodies which are so insignificant to the naked eye, she yet occupies a more important and useful station to us, in her immediate connection with the globe which we inhabit. Such a mode of expression, conformed to ordinary appearances, is perfectly allowable, interferes with no system of philosophy, and is rendered more valuable, as it sinks to the level of the meanest comprehension.

The heavenly bodies are evidently represented in their immediate relation to us, when their uses are specified, "to give light upon the earth"—to distinguish between day and night—to measure out, and to regulate the seasons of the year. The ancients regarded them as signs of another order; and built upon this imagination the splendid, imposing, but unphilosophical and futile theory of astrology. The sacred historian states, that "He made the stars also;" but whether on that day, or whether the account extends to the entire universe, to the sun, moon, and earth only, or to the solar system, of which our globe is a part, and which some celebrated writers have considered most probable, the history does not determine. Of the same nature is the inquiry, whether angels were created on the first day, and as the first work of that day?

—or, whether they subsisted before, and were called into being at some unknown and more remote period, selected from eternity? We only know that they witnessed the process of the creation—which, indeed, they might have done had they been only the first-created on the first day. Of their creation, Moses does not speak; but Job assures us, (or rather the Supreme Being addressing himself to Job,) that, at the creation of the earth, "the morning stars sang together; and all the sons of God shouted for joy."

[Our readers will find a very excellent and learned article on this subject in our correspondence for this week.]

THE PRINCIPLES OF NATURAL, OR MECHANICAL PHILOSOPHY.

No. III.

Gravity.

Experience has discovered in matter, many other properties, equally accidental, that is, which seem not to be absolutely indispensable to the manifestation of material bodies to our senses; but whose coincidence, however, with the primitive conditions of materiality, it is very important to know, because it is applicable to the former in a great many circumstances where it becomes impossible to observe them. Such, for example, is *gravity*. Among natural bodies, obvious to the sight and the touch, we do not find any that are absolutely destitute of weight; that is, which have not a tendency to fall to the centre of the earth, where they are left to themselves.* Since, then, these properties always accompany them, the presence of the one enables us to judge, by induction, that the others exist. Thus, although we can neither see nor touch the air, as we see and touch other bodies, yet we judge that it is a material substance, because that it is heavy, that it can be enclosed in vessels, and that it produces many other phenomena, all similar to those which a heavy fluid ought to produce. The strict examination of these properties will teach us afterwards that there exists several very different kinds of air, which are all so many substances, essentially distinct from one another, evinced by the effects which other bodies have upon them, and by those which they have upon other bodies.

* To constitute gravity, it is not necessary that a body should invariably fall to the ground. Smoke ascends in the atmosphere, and a piece of lead rises in a vessel filled with mercury, from the same cause that makes wood plunged into water mount again to the surface. Withdraw the air, the mercury, and the water, which supported these comparatively lighter substances, and the smoke, the lead, and the wood, will immediately descend. The weight of a body, however, is not the same every where. A mass of lead which weighs a thousand pounds at the surface of the globe, would lose two pounds if carried to the top of a mountain four miles high; and if it could be conveyed as deep into the bowels of the earth, it would lose one pound. The same mass transported from hence to the pole would gain three pounds; but, if taken to the equator, would lose four pounds and a quarter. This variable weight is only the gradation of that mutual and universal attraction, diminishing as the square of the distance increases, which retains the moon in her orbit, and continues the circulation of the planets round the sun.

Attraction.

Attraction is another of those contingent properties which is applicable to the immediate testimony of the senses. We have said above, that the particles of all known bodies act upon one another by attractive and repulsive forces, reciprocally; when we can demonstrate the existence or the action of these forces in an unknown principle, we then conclude that this principle is material. Thus, *light* is not tangible: we cannot recognize in it, extension; it cannot be weighed, at least in our balances: it is so subtle that it escapes all means by which our senses could seize it. But when we make it traverse a transparent body, we find that it is bent and curved in its passage across these bodies, precisely as if it were repelled by a force emanating from their surface, and attracted, on the contrary, in their interior, by the particles of which they are composed. We know also, that they employ a certain time—very small, but measurable—to pass to us from the luminous bodies. In short, when we submit its rays to certain experiments, we find that transparent bodies attract and repel them by certain sides, rather than by others. This assemblage of properties brings us to the conclusion, that light is a material substance, composed of extremely small particles, whose form is symmetrical, with certain faces that are susceptible of particular attractions and repulsions, and which move in space, or transparent bodies, with a given and determinable celerity.

Electric Attraction.

There are even other principles which act upon material bodies, that are neither visible, tangible, *nor capable* of being weighed in any balance; which even till now do not present near so many characteristics of matter as light, and which we have still reason to believe are also bodies. Such are the unknown principles of the two *electricities*, which are called resinous and vitreous. Nothing material, as yet, has been absolutely demonstrated to exist in these principles; nothing, at least, which is explicable without materiality. Indeed, they attract and repel each other mutually: but it is only among themselves that this action is exercised—other bodies do not exercise upon them any kind of force, either attractive or repulsive. Nevertheless, in their diffusion among bodies, and in their passage to one another over the obstacles by which they are separated, these principles act in a manner so exactly conformable to the ordinary laws of the mechanism of fluids, that when we apply the latter to the former, we can calculate beforehand, with the greatest precision, the smallest effect of the phenomena. Hence, it becomes very probable, that they really consist of similar fluids, and that they are consequently material. The same probability is also applicable to the two *magnetic* principles, which can be developed in different metals.

Other Principles.

We have still less data on the materiality of the principle of *heat*. Not only does it fail, like the preceding, in the sensible properties by which *matter* is distinguished, but even the laws of its motion and of its equilibrium, not being completely known, we cannot apply the term to it with the same kind of probability. When we look at the result of experiments upon it, we see it spreading itself through bodies, passing from the one to the

other, fixing itself in them, disengaging itself from them, and modifying the position, the distances, and the attractive properties of their particles. But there is nothing in all this, which clearly demonstrates that this principle is in itself a body. Perhaps the strongest indication which we have of this, consists in some analogies recently discovered between the radiating properties of heat and light, which would lead us to believe that the one of these principles can gradually change itself into the other; that is, that they can acquire or lose, in succession, these modifications by which they produce in us the sensation of vision or of heat. The developement of these analogies, is an object of research of the greatest importance.

These are the only active principles which appear to us to determine natural phenomena; but it is very possible that there exists among them many others, whose subtility escapes the actual processes of our experience. It is in perfecting these processes, in giving them more precision, and in searching for and inventing more sensible indicators, that we shall obtain an extension of power over natural agents, or the discovery of those which have been until now concealed from us.

The principal object of natural philosophy is to verify, by exact experiments, and to represent, by general laws, the accidental modifications and motions which can be produced in material bodies, by the different principles which we proceed to explain; for it is necessary to determine and to measure these modifications, without changing the nature of the bodies that they affect, (changing, however, almost always the actions that they have the power of performing upon them and upon other substances,) before we turn our attention to the phenomena of composition and decomposition, to which the reciprocal action of bodies are subject. It is thus that the study of natural philosophy is useful in chemistry, in medicine, and in physiology, whether in the vegetable or animal kingdoms; and it ought necessarily to precede them.

VARIOUS COMMUNICATIONS.

To the Editor of the

Glasgow Mechanics' Magazine.

Sir,—Mr. Steele, a few nights ago, in announcing the publication of your Magazine to his Class, informed us, that you would most willingly devote a part of your paper to the explanation and illustration of any particular subject, upon which any of his Class wished to be informed. May I therefore request you to explain the mode in which Montgolfier's Hydraulic Ram works, particularly the manner of supplying the air vessel with fresh air. Could you, or any of your intelligent Correspondents, also inform me, of the dimensions of any of these machines, actually constructed, I should be under an additional obligation,—and am,

Your's, &c.

Constant Reader.

Glasgow, 15th Jan. 1824.

We trust the first article will satisfy the inquiries of our Correspondent.

ON LIGHT.

Sir,—In answer to D. A. N.'s question, I send you the following lines. If you think them worthy

of your notice, your insertion of them in your Magazine will oblige,

SIR,

Your's, respectfully,

T. W.

The word which is translated light, in the present version of the Bible—אור, *aur*—signifies not only light, but heat; as will be seen by referring to Isaiah xxxi. 9—Ezek. v. 2. It is used for the sun, Job xxxi. 26, and for the electric fluid, or lightning, Job xxxvii. 3; and it is used for the heat derived from fire, in Isaiah xliv. 16. It may be concluded from the above, (which will bear examination,) that it was caloric, or, what may be termed, the soul of the world, that was created on the first day; without it, no vegetable or animal could have existed; and, as it is the primary agent in all the operations of Nature, it was created just after the formation of the world. Besides this fire, we have also latent light, which may be demonstrated by rubbing briskly two smooth pieces of rock crystal, in the dark; agate, cornelian, and flint, produce the same effect. We can find no occasion for solar light till the fourth day, it being on the third that the vegetable kingdom was formed, and on the fourth it received that which was necessary to its existence; and unless it were to light up the footsteps of Him (to whom day and night are equal), that he might be able with more accuracy to perform the "workmanship of his hands," it would have been quite superfluous, and, I believe, there is nothing in nature to which this term is applicable. I do not suppose the sun to have been formed or created on the fourth day. We are told, that, on the first day, "God created the heavens and the earth:" which, no doubt, included the whole of our planetary system; for it must be absurd to suppose that a part was created, and not the whole.* But though the centre of our system was created at this time to govern the motions of the other planets, yet we are not told that the luminous atmosphere of the sun (the cause of light) was created till the fourth.—(It being now a generally received notion, that the sun is a body similar to our earth, and that the light which proceeds from him, comes from a luminous atmosphere with which he is surrounded, and not from the body itself.) It may be asked—Why was not the atmosphere created with the body of the sun? It was unnecessary, as I before stated; and it may as well be asked—Why was not our own atmosphere created on the first, instead of the second day? It likewise was unnecessary, as it was at that time that the clouds were formed, or the "waters divided from the waters," and they required an atmosphere to support them. Both the sun and our satellite must have existed, as dark opaque bodies, from the first, but were not great lights till the fourth. It is not the body or solidity of the sun and moon that is here spoken of, but their comparative brightness. Owing to my opinion on this subject, I could not give a definite answer to D. A. N.'s question, as I suppose it to be wrong stated.

Glasgow, 20th Jan. 1824.

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* We differ from our Correspondent in this particular. Did not the work of creation itself proceed by degrees? Was not six days employed in its completion? and why may not the same have taken place in the formation of the planetary system?

ON LOCH NESS.

Glasgow, 19th Jan. 1824.

SIR,—In looking over No. III. of your Magazine, I observed a passage from "Mrs. Murray's Guide to the Beauties of Scotland," given as an answer to the question, Why Loch Ness never freezes? which is, certainly, not satisfactory.

Should you think the following solution worthy of a place in your excellent Magazine, it is at your service.

It is a known fact, that water possesses the peculiar property of having a maximum density, corresponding to a particular temperature, and of expanding equally when cooled below, or heated above this temperature. This maximum of density, is found to exist at about 40 degrees of Fahrenheit's thermometer.* It is evident, from this property, that before water can freeze, its whole mass must be cooled down to 40 degrees; for when a portion of water, at the surface, is reduced to this temperature, it is then at its greatest specific gravity, it sinks, of course, and its place is occupied by a lighter and warmer portion from below; this is again cooled, and sinks; another portion takes up its place, &c., and this circulation will go on till the whole mass be reduced to the temperature of maximum density. Now, when a Loch is so very deep as Loch Ness, this process will require more time, and a more intense cold than our longest and severest winters. Hence the reason why Loch Ness never freezes; hence, also, the reason why ice is never found on the sea, except in high northern latitudes.

This property of water was noticed, and this question explained, in a late lecture by Mr. Steele in the Glasgow Mechanics' Institution. M.

P. S.—An Inquirer after knowledge, asks—"What is the best method in practice to put on dash wheels not to shake the other geering?"

Were the writer of this to explain what he means by "dash wheels," and "geering," he might the sooner expect an answer, as it is likely that a great number of your readers may not understand what is meant.

* Mr. Crichton, of Glasgow, has lately discovered, that the maximum density of water takes place at 42.3 deg. Fahrenheit, by a process equally ingenious and satisfactory; and one which has been proved to be correct by several eminent chemists, although their results have not been communicated to the public. We trust that the true number will therefore henceforth be adopted, and that, for the honour of our city, due credit will be given to the author of such an important discovery.

LOVE OF SCIENCE.

Edinburgh, 13th Jan. 1824.

SIR,—I am a Student of the School of Arts in this city, and, as such, if my communications could be of any avail to your excellent Magazine, I would cheerfully transmit them to you. Natural Philosophy and Chemistry have, for some time, presented charms to me irresistible, especially the latter science, which I have studied with enthusiastic energy and pleasure.

I am, SIR,
Your most obedt. Servant,
A.

We feel certainly highly obliged to our Edinburgh Correspondent, for the handsome offer of his communications, and we trust that his valuable example will be followed by many in that intellectual city. It gives us great pleasure, indeed, to observe the enthusiasm which all true lovers of science manifest upon such an occasion, as the mutual communication of knowledge, by whatever means it may be accomplished. We, for our part, do not think that a better opportunity could be afforded than the present, and we trust that our Corres-

pondents and readers will not relax their exertions in the dissemination of useful knowledge amongst all classes of society, and particularly amongst a class which have lately so eminently distinguished themselves in this very laudable object.

ON ANATOMY, &c.

Glasgow, 21st Jan. 1824.

SIR,—I do not perceive a niche in your archives, for Anatomy and Physiology, studies now become popular with the mechanics of this city, not so much through novelty, as from a conviction of their vital importance; and as contributing essentially to widen their information, and increase their comfort by a knowledge of the structure and constituents of the human frame.

Already there is one class open for the benefit of the mechanic, and another is about to be formed on the same liberal principles, which will materially widen the sphere of anatomical knowledge. But the means are still wanting by which the student may get the intricate parts of these sciences solved, similar to those you have provided for the student of chemistry and mechanics.

If it could be attained, consistent with the plan you have laid down, I should be happy to have some information on the following head, either through your own means, or some of your kind contributors, namely, an explanation of the principles of Absorption:—which will much oblige,

Your's, truly,

AN ARTIZAN.

For the
GLASGOW MECHANICS' MAGAZINE.

A CHEAP MODE OF MAKING A BAROMETER.

Take a common phial bottle, and cut off the rim and part of the neck. For this purpose, let a piece of string, or rather whip-cord, twisted round it, be pulled strongly by two persons in a swinging position, one of whom holds the bottle firmly in his left hand. Heated in a few minutes by the friction of the string, and then dipped suddenly into cold water, the bottle will be thus decapitated more easily than by any other means. Let the phial be now nearly filled with water; then, applying the finger to its mouth, turn it quickly upside down,—on removing the finger, it will be found that only a few drops will escape. Without a cork or stopper of any kind, the water will be retained within the bottle by the pressure of external air; the weight of the air being so much greater than that of the small quantity of water within it. Now, let a bit of tape be tied round the middle of the bottle, to which the two ends of a string may be attached, so as to form a loop to hang on a nail; let it thus be suspended in a perpendicular manner, with the mouth open downwards.

When the weather is fair, and inclined to be so, the water will be level with the section of the neck, or rather elevated above it, and forming a concave surface. When disposed to be wet, a drop will appear at the mouth, which will enlarge till it falls; and then another drop, while the humidity of the atmosphere continues. To the truth of this experiment, I can give my *probatum est;* but I shall be glad if any of your scientific Correspondents will explain more particularly the reason of it. Why will not the water remain in the bottle, unless the rim be cut off, which is the fact? Why should the water drop in moist weather, when (as I have tried,) holding the bottle before the fire, or in the sun, will produce the same effect?

You may depend on the correctness of the statements, as I have

made the experiments often, and they always had the same effect.

D. M.

Banks of the Annan, Jan. 19th, 1824.

Although the above notice has appeared several times in the public prints, yet we have received it so often from our Correspondents, that we are inclined to insert it once for all—especially as our present Correspondent has added some queries respecting it, that may be worthy of farther inquiry.

QUERY.

A Correspondent wishes us to insert the following query, being the 25th in Bonnycastle's Arithmetical Recreations.

"To divide 8 pints of wine into two equal parts, by means of two other vessels whose capacities are 3 pints and 5 pints, respectively."

MISCELLANIES.

New Inventions.

At a Meeting of the Highland Society of Scotland, Mr. Graham Dalyell, Convenor of the Committee on Machinery, called the attention of the Society to the models of various useful articles in the departments of agriculture and rural economy, which had been submitted to the Society. Among these were noticed —models of improved frames for corn stacks, by Mr. Erskine, of Mar—of an improved row-boat, transmitted by Admiral Sir David Milne—a smoke-consuming grate, by Mr. Scott, of Queensferry—an improved drill-machine, by William Halliday, overseer to General Dirom, of Mount Annan—a ventilating granary, by Alexander Wilson, at Woodhouselee—and a snow-plough, by Mr. Allan, at Pennycuik.

Voyage of Discovery.

Captain Otto Von Kotzebue is again about to circumnavigate the world, having already been twice round it. The present expedition is appointed by the Russian Government, and is well furnished with every thing that can promote its object. The object is rather to make accurate surveys, than new discoveries; but an astronomer, mineralogist, and naturalist, from the University of Dorpat, go with it, as well as other scientific men. The instruments are made by Troughton and Jones, of London.

Chlorine a Remedy in Scarlet Fever.

Dr. Brown employs chlorine in solution in cases of the scarlet fever, he says, with the utmost success. From a tea-spoonful to a table-spoonful is given every two or three hours, without the addition of any other substance. The solution should be fresh, and swallowed quickly, to avoid coughing; in the sore throat sometimes accompanying a fever, it is more easily swallowed than mucilaginous drinks. As the disease declines, the quantity of medicine is diminished; the whole quantity, in the cases of children, has never exceeded two ounces, and in adults, five ounces.

Glasgow Mechanics' Institution.

We are requested to mention the following Donations, which have been transmitted to the President and Committee of the Glasgow Mechanics' Institution, for the very useful purpose of forming a Museum in that Institution.

From Mr. James Stevenson, a native of Glasgow, now residing in London—Two fine specimens of Minerals, one of native silver, part of a mass of 14 lb. found in Chili, and one of Crystal from Brazil.

From Mr. William Campbell—Two Indian Arrow Heads, brought from the United States; they were turned up with the plough in a field in the State of Ohio, in the "bottom-land," between the two Miami Rivers, about 60 miles from Cinninatti.

From Mr. Francis M. Reid—A Cresse or Dagger from the Island of Java; a Sea-Horse Tooth from the East Indies; several specimens of curious Shells, also, from the East Indies.

From Mr. W. Wotherspoon—Eleven specimens of valuable Minerals.

From Mr. John Scott—A Petrifaction of part of a Pine Tree.

From Mr. Adam Smith—Numerous valuable Petrifactions.

From Mr. Thomas Cowan—An Old Coin found in a garden in Burntisland Parish.

LIST OF PREMIUMS FOR INVENTIONS,

Offered by the Society of Arts.

MECHANICS.—*The Gold Medal or Fifty Guineas,* for a machine for raising coals, ore, &c., from mines, superior to any now in use.

The Gold Medal or Thirty Guineas, for an improved walking wheel, or crane, in which the power can be varied: for a machine to raise water from wells not less than fifty feet deep, by a mode superior to any hitherto known: for an improved method of boring or blasting rocks in mines, &c.: for a method of heating rooms, superior to any now in use: for preventing accidents from horses falling with two wheeled carriages: for improving turnpike and other roads, by combining materials ordinarily employed, so as to form an even, hard, and durable carriage-road: for a mode of preventing the injurious effects attending the operation of pointing needles, and other branches of dry grinding: and for preventing explosion in steam engines, and other closed boilers.

The Gold Vulcan Medal or Thirty Guineas, for the best working drawings of a condensing steam engine in its most improved state, with descriptions, &c.

NOTICES TO CORRESPONDENTS.

We have to apologise to "An Observer" in Tradeston, for our neglecting to notice his communication respecting the Water Clock; it is not new, but it will be inserted at some future opportunity.

We thank J. L. for his communication; but, as we intend to treat such an important subject more in detail than the necessary shortness of his letter would admit of, we shall lay it aside for the present.

We shall endeavour to satisfy "Harmonicus," though we shall have to write to London on the subject.

M. has been led into a mistake, from an error which he will find is now corrected; we thank him, however, for calling our attention to the circumstance.

D. S—— is mistaken; if he will take the trouble to read over the article carefully again, he will find that his difficulty is obviated by the contrary motion of the wheel F, on which the *hour* index is fixed.

W. G. J. has only confirmed the answer to the Interest question; what he mentions in addition, does not fall under it, and, consequently, should be omitted. We think the question is now completely set at rest.

The question proposed by A. is well known; we have inserted it in the usual form.

A. of Edinburgh, would see that we attended to his request in last Number.

M. (Tradeston) and J. P. will be inserted in our next.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement which is the subject of their notice.

To accommodate our Correspondents at a distance, their communications (post paid) may be addressed to the Editor, care of Messrs. E. West and Co. Edinburgh; and of Mr. J. Lawrence, jun. Paisley; by whom they will be transmitted to the Publisher.

SECOND EDITION.

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J. CURLL, PRINTER.

THE GLASGOW MECHANICS' MAGAZINE.

Let Glasgow flourish! still in grandeur rise,
And rear her stately fabrics to the skies.

No. V. *Saturday*, 31*st January*, 1824. Price 3*d*.

DESIGN FOR THE PROPOSED NEW STREET IN GLASGOW.

THE NEW STREET.

This engraving exhibits a perspective view of the proposed New Street, to extend from the Cross of Glasgow to Monteith-Row, and already described in the first Number of our Magazine, to which we refer our Readers. The design, which is by far the most elegant we have seen, does equal credit to the taste and ingenuity of the Designer, and to the admirable skill of the Engraver. Part of the ground plan has been subjoined, to give a proper idea of the situation of the Street. Both of these will serve to indicate the grand effect which such a vast improvement is calculated to produce in our City.

Glasgow, though distinguished for many elegant buildings, taken individually, cannot boast of any regularly built streets, squares, or crescents, such as are to be seen in Edinburgh or London. Many, indeed, of our finest streets, such as St. Vincent-Street, Buchanan-Street, George's Street, George's Square, &c., are almost completely destitute of a regular plan; and though they can exhibit houses and buildings that may vie with those of the finest city in Europe, yet their elegance is entirely lost by the absurd mixture of a variety of different plans, whose origin we can trace to no other source than the caprice of the different proprietors.

We trust that more attention will be given to regularity and symmetry in our future buildings and streets; as the present Street will afford an excellent example of its paramount utility. Indeed, we venture to predict, that as soon as the erection of this Street shall be carried into execution, the value of the property itself will not only be enhanced, but that which is in the immediate vicinity will be increased tenfold; and the City, which is now extending so much to the west, will either become stationary in this respect, or retrograde again towards the east, to the great consolation of a numerous class of proprietors.

We insert the following communication, as it not only explains the circumstances of the plan, but coincides with our own ideas on the subject.

TO THE EDITOR.

Sir,—The accompanying design for a proposed New Street, leading from Saltmarket, near the Cross, to Monteith-Row, having met with the approbation of several of the subscribers, its insertion in your very useful Work, already distinguished for its attention to local improvements, will oblige a very numerous class of your fellow-citizens.

Such an undertaking as the opening up of a direct line of communication between the centre of the City and these most extensive and populous manufacturing districts, of Calton, Mile-End, and Bridgeton, must certainly excite very great interest among your Readers, on account of its evident utility, independent of the highly ornamental effects upon our City, in forming an elegant Street where now stands a heterogeneous mass of old buildings. The undertaking is one of considerable magnitude; but the Joint Stock Company already formed, consisting, as it does, of so many of our wealthy and public-spirited citizens, who are possessed of the requisite *materiel* for carrying it into execution, there is not a doubt that their endeavours will be crowned with success, and that it will stimulate others to similar undertakings, for which there is plenty of scope in this populous City.

I am, Sir,

Your most obedient,

K.

IMPROVEMENTS IN CLOCK-WORK.

To the Editor of the

GLASGOW MECHANICS' MAGAZINE.

Dunfermline, 26th Jan. 1824.

SIR,—Upwards of twenty years ago, I read in the Newspapers different statements respecting pieces of Clock-work to show a perpetual motion. Instead of trying any thing of the kind, however, *which I believe to be next to impossible*, I thought that a common Eight-day Clock might be greatly simplified, particularly in the striking part of its construction. At length it occurred to me, that this might be done without either wheels or pinions; but I always foresaw some obstruction that prevented me from putting my scheme into practice till about two years ago, when I got every obstacle removed from my mind. I then set to work, and succeeded beyond my expectation, as the piece of Clock-work which I invented, is at present going in my shop. On seeing, in No. III. of the *Glasgow Mechanics' Magazine*, a simple method of a going part, and that you request any new information on the subject, I take the liberty to send you a short description of mine, as follows:—

In the inside of the frames there are placed just the common going wheels, with the hammer and spring placed the same way as in common Clocks. The dial wheels are also the same, and likewise the rack and snail; but the hammer-tail answers the triple purpose of hammer-tail, lifter, and rack-catch, in front of the fore frame, behind the rack. It has a lever screwed on the fore end of the verge, and the lower end of the lever is jointed. This joint is driven into the teeth of the rack by a flirt spring, at the hour which gathers in the rack, the same way as the tumbler in common Clocks, tooth by tooth, every other second, till the hour is struck, when a pin at the end of the rack shifts the jointed piece out of the rack; then the pendulum, which is heavy, and meets with little obstruction in the striking of the hour, resumes its usual swing: so that, without either wheel or pinion, she strikes the hour, or repeats the hour if wanted.

I am, SIR,

Your humble Servant,

J. H.

ON THE MAGNETIC NEEDLE.

THE natural Magnet is a hard metallic stone, or peculiar kind of iron ore, of a dark grey, or black colour, compact and very heavy, and is generally found in iron mines. It has no peculiar form or appearance to distinguish it from the variety of mineral stones with which the internal strata of the earth abounds. But its properties of attracting and repelling iron or steel, (nickel and cobalt,) and of pointing to the north when poised or suspended at its centre of gravity, render it an object of great interest to mankind, and give it a distinguished rank among Nature's productions.

The first discovery, however, of any of Nature's secrets never unfolds at once all her astonishing resources. It is chiefly by indefatigable research, by repeated and well-conducted experiments, that we arrive at a knowledge of the causes of things, and of the effects produced by her wonder-working powers. The attractive power, and the communicative virtue of the Magnet

were well known to the ancients; but farther than this, we have reason to believe, their knowledge of its properties did not extend.

The directive power of the Magnet, by which it disposes its poles along the meridian of every place, on the surface of the globe where it may be suspended, so as to point north and south, is a property that was entirely unknown, till about the end of the 13th, or beginning of the 14th century. This happy discovery, one that has been of the highest importance to modern times, gave rise to the invention of the Mariner's Compass; an invention by which the seaman can now traverse the pathless deep with as much certainty as a traveller on *terra firma*, and by which a New World, totally unknown to the ancients, was discovered.

If a Magnet or Magnetic Needle be suspended or supported freely on a point, the one extremity will always be directed towards the north, and, consequently, the other extremity towards the south. This property is called *Polarity*. To account for this phenomenon, some philosophers have asserted, that a fluid, which they denominate *magnetic matter*, flows, without intermission, from the one pole of the earth to the other; and in this manner, by its current, or tide, gives this particular direction to the Magnetic Needle. Others have supposed a large Magnet to exist in the bowels of the earth, which, by its attraction, gives the Magnetic Needle its polarity, and accounts for certain variations to which it is subject.

These opinions are thought to be illustrated and confirmed by the following experiments:—If the north pole of a Magnet or magnetic bar of iron be presented to the south pole of a Magnetic Needle, the Needle will be attracted, and join itself to the Magnet. The magnetic fluid, which is supposed to issue with great velocity from the pole of the one magnetised body, obtains a free passage into that of the other; and this idea of a fluid is strengthened by what we see taking place in electricity: where we plainly observe the electric fluid passing from the electrified prime-conductor to any conducting substance presented to it; for when the substance is removed, we find it charged with the electricity of the prime-conductor. On the other hand, if the south pole of a Magnet be presented to the south pole of a Magnetic Needle, the latter recedes, becomes agitated, and turns round, until it presents its north pole to the south pole of the Magnet. The same thing takes place when the north pole of the Magnet is presented to the north pole of the Needle; *i. e.* it recedes in like manner, and at last presents its south pole to the north pole of the Magnet.

These singular circumstances have also their analogies in the *plus* and *minus*, or positive and negative electricities. Thus, the poles of different names attract each other, and those of the same name repel each other; hence, the former are called friendly, the latter, unfriendly poles. These effects can neither be prevented, nor even diminished, except in respect of distance, by the interposition of any other body, except iron.

Now, supposing (what is sufficiently proved by experience, whatever be the hypothesis respecting the cause of the magnetic action of the earth) that the earth acts on the Magnetic Needle, in the same way as one Magnet acts upon another, it follows, that when a Magnetised Needle is in its natural direction, the pole which is turned

towards the north should receive the name of the south pole, and the pole which is turned towards the south should receive the name of the north pole. Custom, however, in this, as in many other cases, still retains the incongruity; and fortunate would it be, if, in every case, it were of as little importance.

The direction of the Magnetic Needle, which we have stated to be north and south, is true only in a general sense, and, consequently, admits of some variations. Though there are some parts of the globe where the direction coincides, at least to all sense, exactly with the line drawn from north to south, or with the plane of the meridian where the Magnet is situated, yet it will be found, that there are many, or rather the most parts, where it will deviate from this meridian, sometimes to the east, and sometimes to the west, and that this deviation will be at angle, which varies not only in different places, but even at different times in the same places.

What must have been the feelings of Columbus, when, on the 14th September, 1492, he first observed this alarming phenomenon, situated in the midst of the trackless and interminable ocean; at a greater distance from the abodes of men than ever mortal before him had been! How must his mind have been affected, when the circumstance being made known to the crew of his vessel, they rose up in mutiny, refusing to continue their progress through the deep, and demanding an instant return, if it were possible, to their native country! Yes; he must have possessed a courage which, enabling him to persist in an enterprise thus doubly surrounded with danger, was only equalled by his sagacity in forming and carrying into execution a design which never before had entered into the mind of any human being.

This discovery seems to have been so little noticed at that time, and for many years after, although Sebastian Cabot again observed it in the year 1500, that the latter has been considered the first discoverer of this important fact.

After this variation of the Magnetic Needle had been observed by various other persons, and had been pretty well established, at least among navigators, another singular phenomenon, relating to the horizontal position of the Magnet, was discovered. A bar of steel or iron, suspended on an axis, in the same manner as a common balance, and brought into perfect equilibrium before the magnetic virtue is communicated to it, does not preserve that equilibrium after it has been rendered magnetic.

This property of the Magnetic Bar, or Needle, was discovered by Robert Norman, a Compass-maker in London, in 1576. Having been accustomed to finish and hang up the needles of his compasses before he rendered them magnetic, he found, that, immediately after this process, the north pole always dipped, or inclined, downwards, pointing in a direction under the horizon; so that, to balance them, he was forced to put a piece of wax or other substance on the south pole, as a counterpoise; and this he found was continually necessary. He was thus induced to measure the angle of inclination, or the angle which the Needle made, with the horizon, and he ascertained it to be, at that time in London, about 71 deg. 50 min.

About the year 1580, Norman published his discovery of the dip of the Needle; and in his Work speaks, also, of the magnetic declination: the cause of which, he assigns, not to the attraction of a

point in the heavens, as Columbus is reported to have imagined, to account for this phenomenon, but to some point in the earth, which he thought it possible to discover.

(To be continued.)

WONDERFUL PHENOMENA OF NATURE.

Aurora Borealis.

WHAT appearances in nature can be more beautiful, and, at the same time, more awful, than the wild and mysterious motions and colours of the Aurora Borealis! sometimes covering, with inconceivable magnificence, the whole concave of the hemisphere; changing their positions every moment; now resembling vast pyramids, or stretching into innumerable columns, and varying their shapes and colours with the most astonishing rapidity, and with endless caprice—now vanishing in a moment, leaving the heavens sombre and black—and now returning with increased splendour, shedding a matchless glory over all the heavens.

With respect to the Aurora Borealis, many hypotheses have been started by natural philosophers, in order to account for its grand and singular coruscations: not one, however, will stand the test of rigid examination. St. Pierre, who has proposed the latest plausible theory, imagines it probable, that the Aurora Borealis may be caused by the coruscations of ice at the polar circles; since the approach of the vast islands of ice are frequently signified some time before they appear in the horizon, by the coruscations they emit. This hypothesis gains some confirmation from the circumstance, which has been observed by travellers in Lapland and Siberia, of the Aurora Borealis, being attended by a hissing and crackling noise.* One insuperable objection, however, among many others, may be opposed to this theory. If the remarkable phenomenon alluded to, proceeded from the coruscations of ice at the polar circles, it would appear regularly every year; whereas it is now scarcely ever to be seen, and in more ancient times, it was ever still more unfrequent.

Some have imagined it to proceed from the ice-islands themselves, which float, at particular seasons of the year, along the northern and southern oceans: grounding their opinions, principally, upon the observations of Captain Cook—that the ice-islands at the South Pole illuminated half the horizon to a considerable height. This hypothesis is even more improbable than the former. It is liable to the same insurmountable objection of unfrequency,† with the addition of the

* We recollected, while reading the above sentence, that an acquaintance from the north of Scotland once informed us that he frequently heard the noise of the Aurora Borealis, when at home, with a great deal of pleasure. He stated, that he used to listen to it for hours; that it was awfully grand and sublime, and, if we recollect right, harmonious; and that these phenomena were well known to all the people in his neighbourhood.

† Infrequency of occurrence would be a more serious objection than that of observation. But the Aurora Borealis may have taken place more frequently and more regularly than it has been observed. It is now the common opinion, that it originates in the same cause that produces electricity, lightning, and other

utter impossibility of our imagining that any coruscations, caused by objects so comparatively low as ice-islands, should ascend to an altitude of several thousand miles; a height to which, in the opinion of many philosophers, particularly Euler and Mairan, the illuminations of the Aurora Borealis undoubtedly aspire.* To add to the difficulty, it has been observed, by several travellers in Iceland, that the northern lights proceed from the east and south-east, as well as from the north. In Greenland, generally from the east.

Fata Morgana.

But, of all the phenomena of nature, there is no appearance which visits the mind with such indescribable emotion as that which animates every beholder of the Fata Morgana, in the Straits of Messina: a phenomenon that exceeds all the fairy phantoms which the imagination creates, while we are reading the brilliant description of an Arabian poet. The following is a description of it by Father Angellucci:

"On the 15th of August, 1643, as I stood at my window, I was surprised with a wonderful vision. The sea that washes the Sicilian shore swelled up, and became, for ten miles in length, like a chain of dark mountains; while the waters near our Calabrian coast grew quite smooth, or, in an instant, appeared as one clear polished mirror reclining against the aforesaid ridge. On this glass were depicted a string of several thousand pilasters, all equal in altitude, distance, and degree, of light and shade. In a moment, they lost their height, bent into arcades, like Roman aqueducts. A long cornice was next formed on the top, and above it rose castles innumerable, all perfectly alike; they soon split into towers, which were shortly after lost in colonades, then windows, and at last ended in pines, cypresses, and other trees, even and similar. This is the Fata Morgana, which, for twenty-six years, I thought a mere fable." D.

phenomena attended with light. This opinion is corroborated by the crackling noise attendant on these phenomena, so similar to that produced by the electric machine, though upon a much grander scale in nature.

* How does this immense height correspond with the fact of their being so easily heard at the surface of the earth?

THE PRINCIPLES OF NATURAL, OR MECHANICAL PHILOSOPHY.

No. IV.

On the Affections of Bodies.

We have seen in the preceding articles, that all bodies of sensible extension, whose materiality can be instantly verified, consist in the collection of a multitude of extremely small material particles, in which a difference in the mode of aggregation alone, renders the body either solid, liquid, or gaseous. We have also explained the causes by which we are led to consider these particles as inert masses, incapable of self-modification, and susceptible only of *obedience* to the exterior causes, which may solicit them; whether in reality, as observation indicates, the want of will and spontaneous action, forms a general and essential character of matter,—or whether, by an abstraction of our mind, we deprive it of these properties, if they are at any time united with it, to consider separately the assemblage of those which remain after it has been stript of them.

But the material particles being thus considered in an inert state, there follows from this, in the phenomena which their aggregation presents, certain necessary conditions which are applicable to all bodies, independent of the chemical nature of their constituent parts, as being the simple consequences of their materiality. Such are the general laws of *equilibrium* and of *motion*, which are deduced, indeed, mathematically, from the single property of inertia. Although this deduction need not be demonstrated here, being founded, almost entirely, on analysis, we shall, at least, state its principal results. For, after what has been said, it must be perceived that they are of constant and universal application in the study of natural phenomena.

To render this statement simple, we must fix certain fundamental ideas with precision, such as those of motion, rest, and force. We have, indeed, employed these terms already, as being part of ordinary language; it becomes now necessary to give them a fixed and invariable meaning for the future.

Space, Rest, and Motion.

We begin by defining the place where the phenomena are produced. For this, we conceive a space illimitable, immaterial, unchangeable, and of which all the parts, like one another, are capable of being freely penetrated by matter. Whether or not such a space exists in nature, is of little importance to us; we, at least, imagine abstract extension. We place there the particles, the material elements of bodies, and consider, at first, the single fact of their existence. This simple fact is susceptible of two distinct modifications, namely, that the same particle remains invariably in the same place; or that, by the influence of exterior causes, it leaves its place to pass into some other part of space. The first of these states constitutes *absolute rest;* the second, *motion.*

Relative Rest.

But we can further conceive that two or more particles may be displaced at the same time, by a common motion, while preserving their relative positions to one another. Now, if we consider them in their relations to fixed space, they will be really in absolute motion; but if we consider them only in their mutual relations, they will remain the same as if the whole mass were to remain at rest: and if there existed upon one of them an intelligent being, who observed all the other particles, he could not decide, after this single observation, whether the whole system moved or not. This preservation of relations, in the midst of a common motion, is denominated *relative rest.* Such, we conceive, will be the case of many bodies placed in a boat abandoned to the course of a tranquil river. Such, also, is the case of all terrestrial bodies, while they remain invariably fixed towards the same point of the sun. They are at rest among themselves; but the earth, which turns daily upon its axis, impresses upon them a common rotation, and, at the same time, it carries them all along with it, in its orbit round the sun, which, perhaps, carries, in its turn, the earth and the whole train of planets towards some distant constellation. Relative rest is, therefore, probably that rest alone, which, in reality, exists in the system. It is, at least, that alone which we can be assured of from observation.

Relative Motion.

This leads us to make an analogous separation in motion, and to distinguish the *absolute motions* of

bodies, considered relatively to fixed space, from the changes of relative position which can take place among them. The latter are hence called *relative motions;* whether the bodies of the system to which they belong, be found in motion or at rest. For example—the variations in the position of such stars as we perceive on the surface of the earth, are not their absolute, but their relative motions; because the earth to which we belong, as to a fixed centre, has really a motion of diurnal rotation, and an annual motion of circulation round the sun. Even when, by calculation, we have found from these observations the real motions of the stars, such as we would see them from the centre of the sun, we dare not even affirm that these are their absolute motions, because it is possible that the sun, and the whole of our planetary system, move together through space.

Forces; their Direction and Intensity.

After the idea of inertia which experience has given us, we are led to consider the states of motion and rest as simple accidents of matter, which it cannot give to itself, and which it cannot change when it has once received them. Consequently, when we perceive it passing from one of these states to the other, we must conceive this change as produced and determined by the action of exterior causes. These causes, whatever they may be, are generally denoted by the term *forces.*

Nature exhibits to us an infinite number of forces which are, at least in appearance, of different kinds. Such are the forces produced by the muscles and the organs of living animals, the exercise of which depends, for the most part, solely on their will. Such are, also, those which *physical* agents produce, as the expansion of bodies by heat, their condensation by cold, &c. There are even others which seem inherent in certain bodies; such as the attraction of the loadstone for iron, and that which takes place between electrified bodies. There are even forces of the same kind which produce the fall of bodies towards the centre of the earth, the chemical affinities, and the circulation of the planets round the sun.

We are absolutely ignorant of the nature of this kind of forces, and we are unable to determine whether they are foreign to matter, or proper, and belonging to its essence; nevertheless, it is useful and consistent with philosophy to separate them from it in idea, that we may have no more to consider in their physical nature, but the inert masses solicited by the causes of motion.

Every force is characterised and defined according to particular circumstances in its mode of action. The material point to which it is applied must be assigned, in the first place, and then, the *direction* in which it is put in action. It is next necessary to discover its power, or, according to the technical expression, its *intensity.* For this purpose, we choose, arbitrarily, a certain force, whose intensity is taken for unity, and we express by unity that part of the whole force equal to this, that is, which being applied to the same material point, in a contrary direction, will exactly destroy the operation of the first.

We next conceive of two or more equal forces acting together upon a material point, and in the same direction; and we call the force compound which is the result of an intensity the double, triple, quadruple, or, in general, a multiple of the first, according to the number of forces of which it is formed—

so that the intensities are expressed by this number; or, if we choose, we can also represent them by straight lines of different lengths, according to the relations which the numbers indicate.

It is true, that to realize these comparisons, we must be able to determine the relation of the intensity of every force to the power of the motions which it is capable of impressing upon the same body. We shall consider this new question afterwards; but, in the meantime, the mere definition of the relation of forces, and their relative intensities, suffices to fix many general laws, which are constantly observed in their operation.

In a word, to complete the definition of a force, it must be known whether its action is sudden and instantaneous, like a stroke which is not repeated, or whether it is reiterated and continued, lik vity, which, we shall see in t quel, continues to act upon bodies, with as much pow when they begin to move. second mode of action can ev ly be deduced from the fir substituting for the continua the force, a succession of a separated from one another sensible intervals of time, a equal to each other; wheth power of the force which m represented is constant, or pr sively variable in intensity, if the force varies. By this a which takes nothing from t gour of the conclusions, we only to consider the effect sudden impulses impressed up particles of matter absolutely whether in motion or at rest.

(To be continued.)

VARIOUS COMMUNICATIONS.

ON VENTILATION.

To the Editor of the

Glasgow Mechanics' Magazine.

Sir,—A Correspondent, in your third Number, requests information as to the best mode of ventilating churches, or rooms where large companies are accustomed to meet.

I do not pretend to throw any new light upon this subject, but as the point is one which is of great importance to the physical convenience of all, it ought not to be lost sight of.

I recollect of reading a very excellent paper upon this subject—an outline of the general statements of which, I shall endeavour to give you as concisely as possible.

In the case of new buildings, the object may be usually facilitated by a proper attention to this point in the original construction; and in those already erected, windows and ventilators might often be added, in convenient situations, for carrying off the heated and contaminated atmosphere, which, as it ascends, and escapes by the apertures prepared for its emission, supplied by the external air, with human contrivance. The mis however, is, that this process is complete; and is, necessarily, pr of partial currents, which are convenient to many persons tha vitiated or overheated air.

In ventilating a building, two are to be attended to, which, quite distinct, are very often conf namely, the *quality* and the *tem* of the air. In most cases in wh sons complain of the *heat* of la semblies, it is not so much th *heat*, as the *vitiated state* of the phere, that oppresses them. A can exist for a long time in air even beyond the point of boiling provided it be pure; but if, by breathing, or other means, it be d of its oxygen, or impregnated wi terious gases, it becomes incapabl piration, whatever may be its t ture. I have often found churches most oppressive in cold because, every aperture being c closed against the external atm

the vitiated and moist vapours have less opportunity of escaping than in summer, when the doors and windows are thrown open.

To remedy the evils arising from contaminated or overheated air, various methods have been contrived. For the former inconvenience it has been proposed, and the remedy tried, to throw in a gradual supply of pure oxygen gas, by means of a chemical process; but this plan is difficult and expensive, and, in many cases, inapplicable. It only remains, therefore, to *change* the body of air, instead of attempting to *purify* it by artificial processes.

The usual agent employed in artificial ventilation is fire; which, by its property of heating and rarefying air, may be applied in a variety of ways to effect the object. The use of steam, for heating the metallic tubes and surfaces employed in artificial ventilation, no doubt prevents the unpleasant and noxious effluvia of scorched air; but this method also, has its inconveniences; and the apparatus for these purposes is complicated and expensive.

There is, however, a very simple, cheap, and effectual plan, which might be adopted, without inconvenience, in all buildings where the object is simply to *ventilate*, and not to *warm*, the air; as is usually the case in crowded assemblies. The plan is nothing more than to draw off the respired, or heated air, (which always ascends to the ceiling,) by means of a pipe, or pipes, perforating the roof, and opening into the external air, through which pipes a constant and rapid stream of air is to be maintained by artificial heat. The methods of applying this power are various. In a sick-room, for instance, or crowded school-room, or close bed-chamber, or in a ship, let an aperture be made, through the ceiling, or towards the top of the wall, or windows, through which a pipe, open at both ends, is to pass upwards, into the chimney, or open air. With this pipe, a lamp or candle must be so connected that the air which is decomposed or rarefied by its flame, shall escape *only through the pipe*. A constant current will be thus perpetually maintained; the impure air of the apartment will be drawn off; and fresh air will be gradually supplied from the doors and windows, to make up the deficiency.

But a still more powerful, and, often, more convenient mode of effecting the object, especially in churches, would be, simply to fix an open pipe, as before, in or near the ceiling, and to extend it to a stove, or fire-place, either in the building itself, the vestry, or even an adjoining house. The pipe must descend below the level of the stove, and then be bent, and made to pass upwards through the fire, or at the back or side of it, and thence be carried a short way up the chimney, or into the open air. The air in the part of the pipe bent upwards being rarefied by the fire, would ascend and escape, and the deficiency would be supplied by the vitiated air from the interior of the building, through the aperture in the ceiling, and fresh air would gradually flow in at every door, window, and crevice, to keep up an equilibrium. If one pipe were not sufficient, two or more might be used. It is only necessary, in this, and every other mode of ventilation, to contrive that the fresh air flowing into the building, shall have its current so directed as not to be inconvenient to the persons assembled. This may be easily effected by fan-light casements, or other contrivances, so fixed as to deflect the stream of wind to a convenient angle, in order that it may mix with the body of air in the building, without blowing directly upon any part of the congregation.

I am, Sir,

Your's, &c.

D.

P. S. I recollect, once, during my attendance in Dr. Ure's classes, in the Andersonian Institution, of hearing a very excellent plan for ventilation explained, and the theory of the operations adduced, in that admirable style of elegance, for which the Dr.'s Lectures are so remarkable. If any of his students, who are in the habit of taking notes of these Lectures, could furnish you with an account of the plan to which I allude, I am sure it would be very acceptable to your readers, and especially to your querist, as I am convinced that it was the best that could be proposed, though my recollection fails filling up the outline.

ON LOCH NESS.

Sir,—The solution given in your third Number to the query—why Loch Ness is never frozen? is not satisfactory; nor does it appear that sulphur abounds,

either at the bottom or in the waters of Loch Ness, as supposed by Mrs. Murray; and, although sulphur did abound, it would not account for Loch Ness never freezing. We must therefore seek for a solution of this phenomenon in some other way.

Loch Ness is 24 miles long, and generally about 3 miles broad, and throughout its whole length it is 500 fathoms deep, and in some places no bottom can be found with the longest line. It is this amazing depth, at least 2500 feet below the level of the sea, that keeps the Loch from freezing; because, however severe the winter may be, it is never cooled down to the freezing point; and, as the cooling takes place on its surface only, the operation of cooling is necessarily slow, by the cold water on the surface sinking down, and the warmer water below rising up. It is from this immense depth in the bowels of the earth, that Loch Ness never freezes. We are borne out in this, by the waters of Loch Lomond never freezing in any part till far advanced in the winter, and then only in the shallower parts. The unfathomable depths of the Atlantic Ocean never freeze, and from the same cause as Loch Ness, as the cold of winter is not able to deprive it of the heat it had acquired in summer.

I am, Sir,

Your most obedient Servant,

J. P.

We have heard a similar explanation of this phenomenon given, many years ago, by Dr. Ure; and we believed it to be satisfactory, till we received the following communication, which seems to contain very plausible objections.

Sir,—The cause of Loch Ness, and other deep waters, not freezing, is accounted for in the fourth Number of your Magazine, from water possessing the property of having a maximum density. This at first would appear quite satisfactory; but, upon consideration, we will find the same cause would as effectually prevent it from getting warm in summer. From what is stated by your Correspondent, Loch Ness will of course be cooled down, during the winter, some degrees, and will become specifically heavier; the subsequent summer will warm the surface, but in doing so, it will make it lighter; it will then occupy *the top, and prevent* any further com*munication with the water* below. The next winter would cool the surface heated during the summer; this being made cooler, and of course heavier than the water below, will sink, and its place be occupied by another stratum. This circulation will go on till once the whole mass be reduced to the temperature of maximum density; the surface begins then to expand, and of course would remain so till once it was frozen.

I am, Sir,

Your's, &c. G.

Paisley, 27th Jan. 1824.

ON DYING RED.

Glasgow, Jan. 24, 1824.

Sir,—The Society of Arts offer a premium of a Gold Medal, or Fifty Guineas, for the best mode of staining cotton cloth with a red colour, by an immediate application of the colouring matter. I have long been of opinion, that the method of dying Turkey-Red might be facilitated, by trying an extract of the madder either with water or spirits, which should be made when the roots are fresh out of the ground, and thus a great quantity of spirits might be saved. If such extracts were employed, they might be successful in dying either cotton, silk, or wool. The experimenter should be very careful to prevent iron getting into his extract, for if it does get in, the colour will always be of a brick-dust shade. The soda that is used by the Turkey-Red dyers, ought to be made from rock salt; because there is less iron in it than in that which is made from kelp. The common soap of commerce contains iron, less or more, and likewise blood: and all these substances will have a tendency to make a dingy red. There is no substance so widely diffused in nature as iron; and there is reason to fear that it hurts much the fine tints that many fabrics would take on. Perhaps turpentine might be of use in extracting some of the colouring substances. Alkanet-root, with turpentine, makes a fine brilliant red.—If ever the day arrives, that extracts can be made to take up the colouring matter of roots and vegetables, it will be of great importance to the commerce of this country. D. B.

CHEAP BAROMETER.

Glasgow, 28th Jan. 1824.

Sir,—In your last Number, D. M. has informed your Readers of a cheap mode of making a barometer, by cutting

off the rim and part of the neck of a phial bottle, and in that communication has required an answer to two questions, *viz.*—Why an inverted bottle will not contain water unless decapitated? and Why the bottle exhibits the same appearance when exposed to the fire or sun, as it does in wet weather? Although no great philosopher, I shall always be willing to contribute my mite of information, as I think nothing can be more beneficial than an interchange of ideas on any point for which we cannot account satisfactorily to ourselves, and I have no doubt but your Magazine will become the vehicle of much useful information in that way. To the point, then:—Almost all phials have pretty broad rims surmounting the neck; now, in my opinion, the pressure of the atmosphere will only support an area of water of a certain extent and height. What these proportions may be, will require a few experiments to determine:—Suppose the neck of the bottle to be 1-4th of an inch in diameter in the inside, and 1-8th of an inch of projection on each side, in that case there would be an area of half an inch in diameter, which the atmosphere would have to support, instead of 1-4th of an inch only, if the neck were cut, as the mere thickness of the glass would be very immaterial. But few phials are so accurately made as to present a perfect level surface on the rim of the neck; consequently, if part of the rim inclines to one side, the water will naturally slide down to the lowest part, and by that means escape from the bottle.

With regard to the bottle exhibiting the same phenomena when submitted to the influence of the sun or of a fire, D. M. has stated, that there is a small portion of air unavoidably admitted into the bottle when it is inverted; this air, when heated in any way, will expand and expel the water. Even admitting that there was no air at all in the bottle, the heat of the fire, or even the rays of the sun, will have sufficient force to expand the water, on the same principle as the thermometer, and will produce the effect mentioned by D. M.

If you think the subject worthy of farther investigation, I shall try a few experiments, in order to determine the proportions I have alluded to in the former part of my letter. Y.

We shall be very glad to receive the result of Y.'s experiments, as we are of opinion that he has accounted very satisfactorily for the phenomena in question.

SOLUTION.

Glasgow, 24th Jan. 1824.

SIR,—In No. IV of the Glasgow Mechanics' Magazine, page 63, a Correspondent requires an answer to the problem—how to divide 8 pints of wine into two equal parts, by means of two vessels only, whose capacities are 3 pints and 5 pints respectively. It is so simple, that I am almost surprised any person, above ten years of age, would ask such a question: but, as you have inserted the query, perhaps for the information of these adult children, you may insert this answer, viz.—fill the 3 pint vessel, and put that 3 pints into the 5; refill the 3 pint, and from it fill up the 5, and 1 pint will remain in the 3 pint vessel; empty the 5 pint vessel entirely, and then put the 1 pint into the 5 pint; fill up the 3 pint vessel, and put these 3 pints into the 5 pint vessel, and you will have the division required, viz.—4 pints into the 5 pint vessel.

I am, SIR,

Your obedient Servant,

ARITHMETICUS.

Although our Correspondent complains of the simplicity of the above question, it seems to have excited more interest than any one yet proposed; at least, if we may judge of the number of solutions we have received. Since he, however, seems desirous of a difficult question, we would thank him for a solution of such as remain unanswered yet in the Magazine. We will be satisfied even with a solution from him of the question proposed by R. P. S. in the present Number.

We did not certainly insert the above question, because it was difficult, but to please our Correspondents; and it has pleased them, for we have received solutions from S. E., who solved it two ways; from 'A Student.'—H. G.—P. T.—M. M. R.—and 'A North-Country Man.'

QUERIES.

Glasgow, 25th Jan. 1824.

SIR,—If any of your Mathematical Correspondents will favour me with a solution to the following questions, by means of your excellent Magazine, (of

which I am a constant reader,) it will very much oblige,

Your's, respectfully,

R. P. S.

Question.—A gentleman has a circular garden, which contains an English acre of ground:—how long will a cord be, that, fastened in any point of the circumference of the garden, as a centre, will strike an arch that will divide the said garden into two equal parts, by a geometrical construction, with a calculation founded on that construction, without the aid of algebra?

SIR,—If the following queries come within your plan, be good enough to insert them in your useful work.

I am, your's, &c.

W. G.

1. *Query.*—Is there any thing peculiar in the construction of the eye, in very fair-haired people, seeing they are in general near-sighted?

2. *Query.*—What are the most effectual means of counteracting the effects of laudanum, when received into the stomach?

MISCELLANIES.

The Art of Weaving.

It is of importance to the manufacturers and mechanics of the empire, and cannot be wholly uninteresting even to mechanical philosophers, every where, that their attention should be drawn to a "Treatise on the Art of Weaving," which, we understand, will soon make its appearance, written by our ingenious townsman, Mr. Murphy. This gentleman is well known to the trade as one of the most scientific and intelligent weavers in this district, and his work is intended to afford a full explication of his art, embracing all its principles, as well as its multifarious and interesting details. It is written with much perspicuity, the different processes being at once concisely and clearly explained, and well illustrated by a series of engravings. At a future period we may be induced, by the importance of the subject, to give a more detailed account of this work; and we will then confirm our statements in its praise, by such extracts as our limits may admit of. At present we will only farther say, that it has been brought forward at the cost of much labour and expense; and that manufacturers in general will find it their interest not to remain unacquainted with it. The plates do credit to the graver of Mr. Maclure.

Liverpool Mechanics.

A Public Meeting was held in Liverpool, on Friday last, for the purpose of establishing, as a public institution, THE MECHANICS' AND APPRENTICES' LIBRARY, *which has been successfully commenced there, by the private exertions of Mr. Egerton Smith* and some other benevolent individuals. The Lord Mayor being in the Chair, several resolutions were passed, among which are the following:—

That the numerous Schools in Liverpool having created amongst the labouring classes of the community a commendable taste for useful reading, it is desirable to furnish Mechanics and Apprentices with the means of gratifying that taste, by offering them the use of a well-selected Library, subject to such conditions and regulations as shall, hereafter, be determined upon.

That the support and increase of this Library shall be effected by means of Benefactions and Annual Subscriptions, and by Donations of Books, and by such other means as may be deemed expedient; particular regard being paid by a Committee, to be appointed, to the exclusion of such Works as contain polemical divinity, or party politics.

That Benefactors of not less than £2 2s., Subscribers of not less than 4s., per annum, and Donors of Books amounting in value to £2 2s., (to be testimaed by the Committee,) shall be Members of this Institution.

That those Mechanics and Apprentices who are not Members of this Institution, but who are desirous of partaking of its benefits, shall, for the present, be furnished with Books, on being nominated thereto by such Members, and subject to the rules of the Institution.

That a Committee, now to be appointed, be empowered to draw up a Code of Laws for the government of the Institution, subject to the approbation of a General Meeting of the Members, on an early day.

Aberdeen Mechanics' Institution.

At a meeting of a number of manufacturers, master-mechanics, and other gentlemen in Aberdeen, R. Harvey, Esq. of Braco, in the chair, a committee was formed, for the purpose of founding a Mechanics' Institution. The committee advertised a meeting to be held on Tuesday last, which mechanics and others friendly to the Institution were invited to attend, when certain resolutions, respecting the proposed Institution, would be submitted to them.

'wo New Coloured Test Papers.

following account of these test s abridged from the description of them by M. C. Pagot des es, who has used them for many with advantage, in testing for id alkalies.

first is obtained from the violet which covers the root of the radish, (raphanus sativus oblong- e second from the skin of the n red radish, (raphanus vulgaris.) rections with respect to the small are, to scrape off the coloured skin knife, and as it soon changes in to collect them rapidly, put them ece of clean linen, and compress when a clear transparent blue vill be obtained. The test fluid preserved as it is, out of the con- air, or made into a syrup, or laid er by a brush; and the paper thus ed, preserves its fine sky-blue col- n contact with the air, for any of time. The test is extremely e to acids and alkalies.

scrapings of the common radish to be bruised in a mortar before re; they do not yield so much but the tint is very fine either in id state, or on paper, and the test ds is a very delicate one. These ations are recommended above lit- y their being equally sensible, and altered in the air, and by being obtained every where.—*Jour. des* cvi. 136.

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ne Vegetable Principle, Dalhine.

Payen has discovered a new sub- in the bulbs of the Dalhia, which en called "dalhine," and, besides unchrystalizable sugar, aroma, a e, and a fixed oil, albumen, silica, veral calcareous salts.

extract the dalhine, the pulp of lbs is to be diffused in its weight ter, filtered through cloth, the mixed with one-twentieth its t of common chalk, boiled for half r, and filtered. The residuum of lbs is then to be pressed, the solu- nited and evaporated to three- of their volume; 4 per cent. of charcoal must then be added, and hole clarified by the white of an The liquor, filtered and evaporated film form on the surface, *deposits on cooling. All the washings* are to be treated in the same way, and thus 4 per cent. of dalhine, will be obtained from the bulbs.

This substance, when pure, is white, inodorous, purverulent, tasteless, of a specific gravity 1.356, more soluble in hot, than cold water, not soluble in alcohol, but precipitated by it from aqueous solutions. Potash dissolves it, ammonia does not, sulphuric acid converts it into an unchrystalizable sugar more sweet than that of starch.

This substance has some analogy with starch, inuline, gelatine, &c., but differs from them in forming a granulated mass when its aqueous solution is evaporated, by its specific gravity and other qualities.—*Ann. de Chimie.* xxiv. 209.

Pyrophorus from Tartrate of Lead.

Dr. Gobel, whilst working with the tartrate of lead, remarked, that, when heated in a glass tube, a very perfect and beautiful pyrophorous was produced.—When some of the dark-brown mass thus formed, was shaken out into the air, it immediately inflamed, and brilliant globules of lead covered the ignited surface; some of these changing, by degrees, into litharge, offered a very beautiful appearance. The ignition continues much longer than with other pyrophori, which circumstance, with the facility of preparation, make it a convenient means of obtaining fire.

The inflammation of these substances, as Dr. Gobel remarks, has been attributed, principally, to the presence of potassium, but this substance affords a new proof that other metallic compounds are susceptible of spontaneous inflammation on the accession of air.

Donations to the Museum of the Glasgow Mechanics' Institution.

From Mr. Thomas Duff—three Silver Coins and two Petrifactions.

From Mr. Peter Pattily—two Specimens of Copper Ore.

From Mr. George M'Lehose—brought from South Carolina, North America, a Rattle-snake Skin—a Wild Cat's Skin—a Tobacco Pipe, made by the Catawba Indians—three pieces of Stone, found near Columbia, made and used by the Indians for points to their arrows; and a small piece of Stone, of the kind they

use in making axes—a small Gourd, often used by the Americans instead of a cup—one Cent—one Cotton Ball—and a Ball of Argillaceous Oxide of Iron—with the kind offer, if required, of a variety of Foreign Seeds.

From Mr. Reid—a piece of Fibrous Gypsum.

From Mr. Peter Parker—a Petrifaction and Nut.

From Mr. Brown—a number of Petrifactions.

From Mr. Alex. Burton—a Specimen of Barytes—Scotch Garnets with Mica—compact Mica—pure Slate Mica Calxspar—and a Petrifaction of Shells.

From Mr. Steel—a parcel of small Petrifactions.

From Thomas Muir, Esq. of Muirpark, about forty specimens of Minerals.

NOTICES TO CORRESPONDENTS.

J. O. and D. will notice, that their observations have been anticipated. When D. favours us with any future communications, we trust he will avoid such observations as those which were prefixed to his otherwise accurate statements.

G. G. is under consideration.—J. F. will find a note at the Publisher's.

'A Student' asks if Natural History comes within the limits of our Magazine. We presume he has not seen the Prospectus; indeed, several of our Correspondents seem to have forgot it, otherwise they would not find fault with us for inserting some articles which we considered as useful, and as certainly coming under our plan.

A. B.'s mode of discussing the merits of any question, does not suit our pages, especially when it is so much a-kin to a "farrago of nonsense;" had there been less "rottenness in the state of Denmark" in his communication, it might have been inserted.

T., and 'A Friend to the Arts in Great Britain,' in our next.

We shall try to oblige J. L.—M., D. R., and 'A Constant Reader,' must be postponed.

We sincerely thank W. G., on the Banks of the Levin, Dumbartonshire, for his just observations, and trust he will favour us with his intended communication. We are sorry that the solution of the wine question by A., St. Vincent-Street, came too late; otherwise we should have been glad to accept of his agreeable proposal.

We shall be very glad to receive M * N.'s communication on the subject he mentions; and especially on the other branches of knowledge which have engaged his attention.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement which is the subject of their notice.

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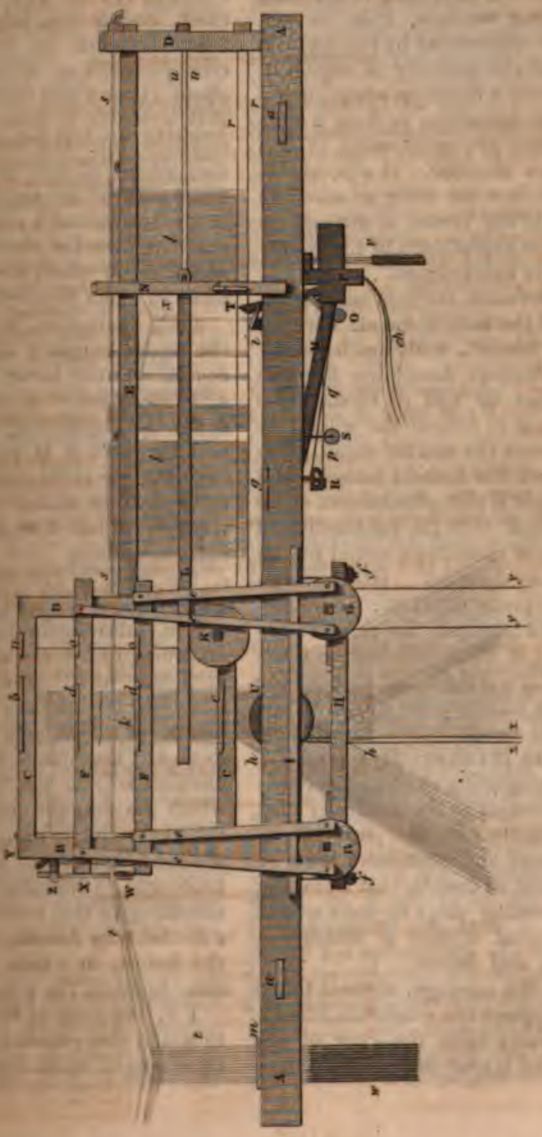
THE GLASGOW
MECHANICS' MAGAZINE.

" Genius is praised, but hungry lives and cold."—*Gay.*

No. VI. *Saturday, 7th February,* 1824. Price 3*d.*

MR. CROSS'S NEW WEAVING MACHINE.



NEW WEAVING MACHINE,

INVENTED BY MR. JAMES CROSS, PAISLEY.

Mr. Cross's new harness for superseding the use of draw-boys, being constructed on principles very different from any thing in common use among weavers, it is, as yet, but little understood by the few who have had the curiosity to inspect it, either from a desire to adopt such a great improvement, or from a wish to examine the mechanism of this ingenious machine. It will, therefore, we hope, be doing an essential service to the Trade, to attempt to give some explanation of the principles of its construction.

The inventor, far from being satisfied with the state of the old harness, applied himself, with much assiduity, to discover something fitted to the object he had in view. This object was to reduce the weight so much, that the weaver could, with ease, work the harness himself; and he thought if this grand object could be attained that the superseding of the use of draw-boys would not be a vain speculation. His research did not prove abortive; for he discovered a principle, the proper management of which relieves the operative of the weight, by making the machine counterpoise it. Hence it has been denominated The Counterpoise Harness Machine.

The engraving exhibits a geometrical elevation of the machine; and, consequently, all the parts of the frame-work and machinery must be considered as double, that is, having corresponding parts on each side of the internal system of knotcords, harness, and lashes.

A A, the *carriage*, or main frame that supports the whole machinery, which rests upon the cape of the loom, and is used instead of the box and carriage, in the ordin of harness-weaving. The consists of two parallel wood, each 4 inches deep, thick, and 9 feet long, fi tened together by means cross pieces, *a a*, at the di about 1½, or 2 feet from ea B B, *uprights*, or parts of t mortised into the carriag dimensions, as well as tho other parts of the machine easily determined by const scale from the length of the according to which they ar down in exact proportion.

C C, horizontal bars, the upper supports the *s board*, and the lower the *directing board*. *b*, the *s board*, for supporting the l and harness; it is perfora from 400 to 1000 small h cording to the size of the through which the lacin harness passes, and is *c*, the *neck*, or *directing b* guiding the harness, (ir rollers,) also perforated w according to the *tye* or pa harness. *d d*, *trap boa* preparing the harness to r figure, in which *saw cuts draughts* are made to a knotcords. *k*, the *knotc* which the draught, or sh tained for the figure. *n*, *pension board*, for the knotcords, perforated wi according to the number *o o*, the *trap boards*, for the lashes, in which are *cuts*, to admit the preparin

F F, the arms of the *tr* to which the pushers are by means of small screws

, the *pushers*, connected with rms of the *trap boards*, and otators, to produce the counse. G G, the *rotators*, which ce the counterpoise, having axles in their centres, passing gh from the one side of the ne to the other. H, horizonrs, upon which the axles of tators revolve. *ff*, iron pins, screws and nuts, to raise or ss the *rotators* at pleasure. nnecting *shafts*, to produce aneous motion to the *rotators*. e *horls*, for moving the *lash-*, having an axle passing gh their centres, with a series ntric *horls* on it, essential for g power in the operation of ing the lashes.

the perpendicular, and L, the ntal shafts of the *lash-driver*, projecting arms of which are l four teeth, two above, and elow, to operate upon the cording *cross bridles*, when the river is passing below the *inplane*. M, the *tumblers*, or in which are fastened small , to pull down the *lashes;* the represents the *lash* drawn at t. O, the *hooks*, for catching eads of the lashes. P, the in which are placed the rs, each divided by wires fixhe frame. T, the *escapement*, essing open the hooks, and ng one set of lashes to escape, other to enter. R, the *hook* , connected with the escapein which wires are fixed, that n the under part of the hooks; l it is placed a wire spring for ring the position of the hook r.

a *roller*, half cut away in the , to allow the tumblers, or to play, while the machine operation. To this roller is wo strings, *p*, *q*, to cause the roller to revolve in gudgeons; the one being connected with the hook presser, and the other fastened to the escapement. *g*, a board, in which screws are placed, for supporting the levers at the centre of motion. *r r*, *grit cords*, to guide the bridles of the lashes. *s s*, the *simple*, consisting of a series of cords, according to the pattern required, fastened, at the right end, into a reed; and, at the left end, to small brass *males*, through which the knotcords pass, and kept in tension to the left, by small linen or harness twine, generally fastened to the weaver's window. *t*, *twine*, fastened to the window, to counterbalance the simple. *w*, *lead weights*, to keep the simple in tension. *v*, *lead weights*, to balance the *levers*, or *tumblers*, when recovering, after having prepared the lash. *u u*, *grit cords*, for keeping the heads of the lashes open, that the hooks may receive them. *l l*, the *lashes*, placed upon the simple, for working the figure. *x*, a *cross bridle*, which is depressed by the hook pulling down the lash with it in the act of weaving. *h h*, the *harness*, in which the warp is placed, attached to the knotcords, at the neck board. *i*, the *inclined plane*, over which the lashdriver is raised, by means of a brass horl, in the act of treading the web; this horl is connected with the treadles, by means of the cords.

X, are *bias cords:* and W, *weights*, to keep the knotcords in tension, when the draught is drawn; only necessary when two trapboards are used. U, a *horl*, to act as a pulley in conducting the cord *z*, which moves the lash-driver. Y, a *heddle leaf*, for keeping the males upon the knotcords level with the simple. *m*, a *holey board*, to keep the weights in order. Z, another *holey board* to keep the bias weights in order.

y y, *cords* to put the counterpoise in operation, and for raising the draughts. *z z*, other *cords*, of which the one on the right hand is for preparing the lash with the ground shot or treadle; and that on the left, for bringing forward the lash-driver over the inclined planes exactly behind the cross bridles. These four last mentioned cords are all that are required to connect the upper and lower operations of the machine, and the treadles of the loom, upon which it is placed.

The great object of Mr. Cross's invention is to enable the weaver to dispense with his assistant, the draw-boy, and to work, at the same time, with equal ease, and with greater accuracy.

In imitation India shawls, and other figured fabrics, the machinery for forming the figure is called the *harness*. The heddles, (styled the gear in England,) as every one knows, raise and depress the alternate threads of the warp, to receive the weft in working plain cloth. Now, the *harness* may be described as a second set of heddles, placed 8 or 10 inches farther from the weaver, of no use in working the ground of the web, but employed solely to lift those particular threads of the warp which at each moment require to receive a thread, or a shot of coloured weft, to form the flower. A shawl generally contains several flowers—or rather rows of flowers (6, 8, 10, or more)—in its breadth. One of these flowers may be considered as the elementary portion of the shawl, (as a company is in a regiment) because the arrangements for forming that flower being completed, there is nothing more to do but to repeat these arrangements in regular order as often as there are flowers in the breadth of the web. The harness, like the heddles, embrace all the threads of the warp, but they are set off into divisions, called *parts*, corresponding to the number of flowers in the breadth of the web. If, for instance, there are ten flowers in the breadth of the web, the harness is separated into ten *parts*. Two threads (sometimes three or four) are called a *male*, and put through the eye, or opening, of each line of the harness (for it is formed of small threads or lines); and these must be so disposed,

that the weaver has it in his pow
any two threads without moving
But here we must explain, that
not require the power of lifting a
male (or two threads) out of th
web—but out of *each* flower in the
—for whatever motion is require
part, is required for them all. T
ness, therefore, set off into *part*
ried perpendicularly upwards, an
to strong cords, called *tailcords*,
a way, that a line, or *male*, out
flower is connected with a single
and, consequently, by pulling one
cords, we lift two threads of war
part, or flower, and the threads
are in positions exactly corres
If, for instance, there are ten fl
the breadth, then, by pulling a si
cord, we raise twenty threads—b
two, we raise forty—and by pu
whole tailcords we raise the who
To raise these threads (by a cor
we shall presently describe) is t
of a boy called a *draw-boy*. But t
er will readily understand, that
any given number of threads all
and allow the shuttle to pass
beneath them, would not make
at all, and that the coloured weft
flower must be *inserted* betw
threads of warp—not passed belo
While the boy draws a part of t
up, therefore, the weaver, by
the treadle with his foot, makes
two leaves of his heddles desce
carries down a fourth, or a half
threads the boy has raised, and
shed, into which the shot of colou
is thrown, to form the flower.
the threads of warp have little e
to carry them back into their h
position, after being thus raise
lace, or line of the harness, (hold
threads of warp,) is loaded with
eight inches of long slender le
placed below the web. This gr
creases the labour of the draw-b
has often, at a single pull, to rai
40 pounds through a space of
inches. To enable him to accompli
would otherwise be beyond his s
a simple but ingenious contrivanc
ployed, which we shall now expla

We described the laces or line
formed the harness as being carri
pendicularly upwards, and tied t
called tailcords—one lace from *ev*
or flower, being united to a sin
cord. The tailcords, after being

lines of the harness, are passed pullies, then carried horizontally the roof of the shop, over a space or 12 feet, and made fast to the by a wooden rod—so that the harith all its lead weight is suspended upported by this rod. Now, the vance by which the draw-boy is to operate on the harness, is this. one knows, that if a cord, stretched orizontally, is fastened at one end, l over a pulley at the other, and l with a weight, a person, by pulling iddle of the horizontal stretched downwards, will raise a much r weight than by simply pulling rd doubled over the pulley. The r takes advantage of this principle. tailcords, as we have seen, are ied out horizontally along the roof length of 10 or 12 feet. To the of each tailcord another cord, a *simple*, is attached. To these the boy's force is applied. By ng them with his hand, and pulling vards, he depresses the middle of orizontal tailcords, and so lifts up rt of the harness, and the part of equired.

se who look at a shawl, will ob- that the breadth and form of the and the colours which compose it, ery moment varying as the work progress. Now, by what means is y to find out the proper *simples* to that the coloured weft may be in at its proper, but ever-vary- osition? It is done in this way. attern to be worked is delineated aper divided into minute squares es corresponding to the threads of and weft. It is then read off, as alled, not by the weaver, but by a whose special business this is. as the *simples* or pulling cords, amount to many hundreds, lying ular order before him, detached the loom. Guided by his pattern, ects all the *simples* that require to lled for one throw or shot of co- weft: he attaches short cords of inches in length (or rather one ord often doubled) to these—then the short cords together into a which is called a *lash*. Let us e this to be the beginning of the , and that it has here three colours , blue, and green—that is, three s on one line across the web. This mbracing perhaps 5, 10, 20, or 50 *simples*, answers only for one colour, the red for instance. He then selects in the same way the *simples* for the blue, attaches the cords, and forms another *lash*; and then those for the green. These three *lashes* are then hung by their loose ends upon a small rope, and the whole is called a *cross bridle*. In the same way, the workman reads off the other parts of the flower as they come on progressively. Let us now suppose the *simples*, with these *lashes* attached to them, put up in their proper place, fastened to the *tailcords*, at the roof, with their other end fixed to the floor—standing erect, in regular order, like strings of a harp, but very close together. The draw-boy by pulling the first *lash* outwards with his *right* hand, separates from the group the particular *simples* which require to be pulled for a shot of red—he grasps the *simples* thus separated, firmly with his *left* hand—applies his force or his weight to them—raises the required threads of warp, (a fourth or half of them being depressed by the weaver to form a *shed*,) when a shot of red is thrown in. Quitting these *simples*, which regain their place among the rest, while the threads of warp, at the same time, descend to their former position by the leaden weights attached to the harness, he pulls the next *lash*—disengages another set of *simples* from the rest—grasps them, and pulls in the same manner—when a shot or thread of blue is thrown in. The same operations are repeated for the green. As these are all the colours in the flower at this place, the weaver now throws in a shot of white weft (or any other colour as the case may be), for the *ground* or body of the web, extending through the whole from side to side. And during all this time, though the shuttle has passed four times from side to side, (or rather four shuttles have passed once each,) the web has increased in length only by the thickness of the ground thread. The three coloured threads for the flower are merely thrown in at particular parts, and in one line. For the figure forms no integral part of the web. It is inserted into it, as if it were done by a needle, and may be taken out of it without the smallest injury to the body or ground of the shawl.

This first *cross bridle* having done its duty, is set aside, by sliding it up or down, for the *lashes* are made to slide on

the *simples*, as the *cross bridles*, which unite the lashes, slide upon guiding ropes or cords. Another cross bridle is then slid into the place. The reader will now comprehend that the *harness*, with the attached *tailcords* and *simples*, are solely for *lifting* the threads of warp for the flower; and that the *lashes* are contrived solely for *selecting* and separating the particular parts of the harness to be raised at each shot or throw of weft, for the figure. There must be as many *simples* attached to one *lash* as there are *males* (or double threads of warp) to be raised for that shot in each *part* or flower; there must be as many *lashes* in a *cross bridle* as there are colours in the flower at that place; and there must be as many *cross bridles* prepared as there are single threads of *ground* weft in the *length* of the flower. This description applies solely to the body of the web. To avoid prolixity, we say nothing of the border, which requires a particular arrangement of part of the harness for itself.

A figured web with colours, it will be seen, is worked by two persons—one of them a boy, indeed, but whose labour is often heavy enough for a man. The object of Mr. Cross's invention is to enable one person to do the work of two—to enable the weaver to perform the draw-boy's labour as well as his own; to do this without any increased exertion, and, at the same time, to work with greater accuracy. What has been premised will put an attentive reader in a situation to comprehend the nature of Mr. Cross's improvements.

Mr. Cross employs harness of the usual form, loaded with leads. It is attached, in the common way, to cords corresponding exactly to the *tailcords*, but called *knotcords*. The *knotcords* are not passed over pullies, and spread into a tail along the roof of the shop, but are carried right up through holes in three boards, and fastened to a part of the frame above. The three boards lie horizontally. The lowest, which is fixed, is called the *directing* board, and is merely intended to keep the knotcords in their places. The two other boards, called *trapboards*, move up and down perpendicularly, and their use is to lift the particular *knotcords*, and by them the particular threads of warp required for each throw. This is accomplished in the following manner:—Each *trapboard* is perforated by as many round holes as there are knotcords employed in the work. These holes are about a quarter of an inch in diameter, so that the *knotcord*, with a knot upon it, can pass freely through. Each hole has, on one side of it, a slit or *saw draught*, passing a little way into the wood, wide enough to let the cord pass through freely, but *not the knot*. Now, an apparatus is employed which pulls a certain number of these cords to that side of the hole where the slit or *saw draught* is. They enter the saw draught; another motion of the weaver's foot makes the trapboard ascend; and as the knots which are above the board are too thick to pass through the *saw draught*, all the cords so drawn aside are lifted up, while the others remain unmoved. This has precisely the same effect as the pull of the draw-boy in the old loom. It raises the required threads of the warp for the shot of coloured weft to be thrown in.

Thus, then, the machine raises any part of the warp, but we want another to *select* or separate the particular threads to be raised at each throw. This we shall now describe. Let the reader conceive a multitude of the knotcords passing up perpendicularly through holes in the trapboard, and suspended from a part of the frame above. To each of these knotcords, at a little distance above the trapboard, a string is attached, then carried along *horizontally*, and fastened to the frame. These strings are placed exactly like the *tails* in the old looms; but they answer the purpose of the *simples*. One end of each string being fast, and the other attached to the knotcord, if we shorten the string by pulling it down in the middle, we necessarily draw the knotcord to that side, and bring it into the *saw draught*. To pull the horizontal strings down in this way, *lashes* are attached to them, and slide upon them, exactly as they do on *simples* in the old form—only, in the new loom, the *lashes* hang down perpendicularly. Each *lash*, at its lower end, has an eye made of cord, which keeps always open by other cords; and, when the *lash* is in its proper position, a lever, called a *preparer*, moving on an axle, and situated below, darts a brass hook into the eye of the *lash*—drags it downwards, and, shortening the horizontal strings, by bending them down at the middle, draws aside the particular knotcords required into the slits or saw draughts. The same motion of the

weaver's foot now raises the trapboard, which carries up with it all the knot-cords so drawn aside, while the others remain unmoved: thus, the threads of warp required to be raised for a shot of coloured weft are lifted, and the same effect is produced as by means of a draw-boy. The *lashes* are placed on *cross bridles*, one for each colour, as in the other case. Supposing the throw now described, to be for the red colour; then a second lever or *preparer*, (side by side with the former, and on the same axis,) set in motion by the weaver's foot, catches another *lash*, pulls a second set of knot-cords into the *saw draughts;* the trap-board rises again, and another shot of a different colour is thrown in. In this way the process goes on. There must be as many levers or preparers as there are *lashes* in a *cross bridle*, or colours in the flower.

The first *cross bridle* or set of *lashes* having done its business, is now to be set aside. It slides at one end on the horizontal strings or *simples*, and at the other end, on strong directing cords, as in the old loom. A light wooden erect frame, called the *lash-driver*, moving by small castors on two horizontal beams, now presents itself; and placing four legs or pins against the *cross bridle*, disengages the eyes of the *lashes* from the hooks, slides the *cross bridle* along to the right, and sets it aside. But the series of *cross bridles* with their *lashes* are all connected to one another, at determinate distances, (three or four inches,) by means of small cords, called *stretching bridles*, and the very act of setting one aside brings another into the proper place for working. The preparers act again, and the same round of operations being repeated, the *lash-driver* must return to its first station to be ready to push this second set of *lashes* aside also. In coming back, it is raised up an inch or two, by a simple but ingenious contrivance; so that its legs pass to the left, *over* the *cross bridle*, without touching it, and place themselves before it. It then moves back again to the *right*, shoving the *cross bridle* along with it. We shall now attempt to describe the machinery by which the *lash-driver* and the *preparers* are moved. There is a particular *simple* placed among the rest of the *simples*, attached to a small piece of brass plate on the top end, and, on the lower end of the plate, a small piece of twine is fixed to a *knotcord*. Upon the last *lash* of every set of *lashes*, whether one, two, three, or more, there is always a tack placed by the *flower-lasher*, upon this particular *simple;* and, when the last *lash* of the set of *lashes* is prepared by the hook for the reception of the *spotting-weft*, or shot, the operation necessarily acts upon this *simple*, by pulling a corresponding *knot-cord* into the *saw draught*, fixed on a horl connected with the treadle; so that, when the weaver's foot is put upon the machine-treadle, the *lash-driver* is forced back. This part of the operation of the machine is performed by cords and pullies, with great ease and accuracy, and is all derived from the treadles. There is much ingenuity in many parts of it; but it is less characteristic of the improvements than the parts we have described, and it scarce could be rendered intelligible by mere verbal description.

To indicate to the weaver the changes in the colour, there is a dial-plate fixed on the loom before him, which operates by an escapement, and points out with accuracy when any colour comes in or goes out.

We have still some explanation to offer respecting the trapboards, in the construction of which, Mr. Cross has shown peculiar ingenuity. We mentioned already that there were two trapboards, though a superficial observer would think one sufficient for every purpose. But this, which appears, on a first view, to create unnecessary complexity, is perhaps the most admirable contrivance in the whole machine. The two trapboards are placed the one below the other, a happy arrangement, and the very basis of the construction; not only useful in counterpoising, but, when the first lash is raised and fully opened, by means of the one trapboard, the second lash is prepared by the same motion; there being two set of knots on the knotcords, the one lash rising and the other sinking with ease and facility, each shed meeting alternately half way, exactly as if it were a plain web. They are moved up and down by cranks attached to the opposite sides of the same axle; so that when the one board is raised, the other is depressed, and *vice versa*. Hence, they serve as mutual counterpoises, and the descent of the one facilitates the elevation of the other. It will be recollected, that, in consequence of the lines of the harness being all loaded with lead wires, the

draw-boy has sometimes to raise a weight of two stones by an instantaneous pull, while the weaver has to exert a pressure perhaps half as great, with his foot, to make the *shed*. But, by the happy use of the principle of counterpoise, the descending trapboard operates as a moving power to raise the other. There is a judiciously contrived system of mechanism in the treading department of the loom, making one treadle serve the united purposes of pressing and tweeling, instead of eight in the common way; and which is much lighter in the operation, according to the inventor's definition, in the proportion of four to one; most essential in many kinds of work, and an improvement that may be extended to other fabrics not connected with harness work. To return, however, to the counterpoise. If there is, for example, a weight of 16 pounds on the one trapboard, and 16 pounds on the other, the weaver has only to apply the slightest pressure to put the machine in motion; and what would have cost the draw-boy a great effort, scarcely costs the weaver any effort at all. If, again, there is 16 pounds on the one board, and 10 on the other, the weaver has only to press with a force of six pounds to raise the former and depress the latter.

But there are many other advantages besides this, resulting from the construction of the trapboard, which render it an invention of very great value. At present, several great evils attend the application of the draw-boy's force. First, there is no regular measure to his efforts—he pulls sometimes too high, sometimes not high enough. Secondly, he raises the harness by a violent jerk, and lets it descend by another, which is apt to strain or break the warp, and renders the use of very light and fine yarn impracticable.—Thirdly, the pressure on his arm is greatest when the *shed* is at its utmost expansion; and hence, when tired, he is apt to let the *simples* go before the shuttle is entirely through, which makes bad work. In all these points, the trapboard has a decided superiority: 1st, It raises the warp at all times to one and the same determinate height; 2d, It raises it in the safest possible manner, by a motion slow at the beginning and end, and rapid only at the middle—with a pressure, in short, which comes slowly on, and goes slowly off; 3d, The power increases with the weight of the work, and, at the extreme expansion of the *shed*, so far from the force required being then greatest, the weaver's exertion (we mean in raising the warp) may be said then to cease, for the trapboard entirely supports itself.

We have spoken of the trapboard as worked by cranks. This is not literally the case. Mr. Cross has not employed cranks; but, what is exactly equivalent, he employs two iron pins, fastened into the side of a wheel, upon which are placed the under ends of two long rods or arms, while their upper ends are attached to the trapboards. This wheel, by a cord passing to the treadles, is driven half round and then back again, while the rods alternately thrust up and down the trapboards to which they are fixed. Persons who have considered the motion of the crank and beam of a steam-engine will readily understand, that, in this case, when the under end of the rod is right above, or right below, the axis of the wheel, the vertical motion of the rod is extremely slow; the power in the same proportion great; that in either of these positions it would support itself with any load; and that the motion is rapid only near the middle of the intermediate space.

Mr. Cross's invention has material advantages in another part of the labour now performed by the boy, and requiring rather care and accuracy than strength. The draw-boy, we must recollect, has often to do his work with much rapidity. When he pulls a *lash* with his right hand, he brings the particular *simples* wanted only a very little way out from the rest. In thrusting in his other hand to grasp the *simples* thus detached, sometimes one or two which he should pull escape his hand, and sometimes he catches one or two which were not included in the *lash*. In both cases, the perfection of the work is injured. In Mr. Cross's looms, the machinery employed entirely precludes these chances of error.

To these, and many other particular advantages, which want of practical skill renders us unable to describe, we must add the general advantage of enabling the weaver to dispense with the assistance of his draw-boy. The saving which this produces, of 3s., 4s., or 5s. a-week, is but a small part of the benefit. At present, the weaver lies very much at the mercy of his young associate. If the latter plays truant, or sleeps too long

in the morning, or falls sick, the weaver must remain idle, or find another helper; and as the labour renders considerable training necessary, this is not easily done.—His work is, besides, at all times exposed to accidents from the idleness, caprice, or inattention of the boy, to say nothing of the discomfort arising from cross humours and little bickerings between fellow-labourers so dissimilar in age, habits, and dispositions.

We understand that Mr. Cross has spent 8 or 9 years in gradually improving and perfecting the machinery of his loom.—There is much mechanical ingenuity displayed in many parts, of which we have said nothing, because our object was not to describe the whole, but only what was most characteristic of its qualities and powers. We understand that it may be employed with equal advantage in weaving figured goods of every description where harness is used. To add to its other recommendations, it is not expensive, and requires but little training to put the weaver in a condition to work with it. This loom is by no means the only gift Mr. Cross has made to the arts of his country. We find from a pamphlet, that he is the author of various other improvements and inventions relating to weaving machinery. Looms, too, of the new construction, are already working in Paisley, and we learn, from the same pamphlet, as well as other sources of information, that the persons who have adopted them speak in the most decided terms of the advantages they possess.

For ourselves, as we have no pretensions to the technical knowledge which alone can entitle any one to speak with confidence on the subject, we have uttered nothing except on the testimony of persons well informed. Knowing, as we do, the general aversion of practical men to new schemes and new modes of operating, nothing gives us so strong an impression of the value of Mr. Cross's improvements as the high estimate formed of their importance by those who have most experience. While we have heard them speak so favourably of Mr. Cross's loom, we have felt disposed to join in their expressions of regret, that means cannot be found to render an improvement from which our manufactures must derive great advantage, more beneficial to the inventor. Though not a very aged man, an asthmatic complaint has reduced him to a state of great debility, and almost disabled him from personal exertion. The trustees have given him a hundred guineas; and the manufacturers in Edinburgh have treated him liberally; but we trust that something more will be done for him in Glasgow and elsewhere. From all we have learned, he is, in every way, deserving of patronage. At least, we know that the intercourse which several intelligent manufacturers have had with him, left a strong impression upon their minds, in favour of his modesty, sobriety, good sense, and integrity.

[We have been chiefly indebted for this important Article to the Editor of the *Scotsman*.]

ON THE MAGNETIC NEEDLE.

Obscure, unpriz'd, and dark the magnet lies,
Nor lures the search of avaricious eyes,
Nor binds the neck, nor sparkles in the hair,
Nor dignifies the great, nor decks the fair.
But search the wonders of the dusky stone,
And own all glories of the mine outdone;
Each grace of form, each ornament of state,
That decks the fair, or dignifies the great.—*Claudian.*

Secular Variation.

After the discovery of Norman, the variation of the compass began to be universally observed. These observations were carefully collected, and attempts were made to establish a theory on the subject. Gellibrand published a tract, entitled a " Discourse Mathematical on the Variation of the Magnetic Needle," which excited a very considerable degree of interest at the time, especially among navigators. Having compared the different variations that had been observed, he

found that the needle was continually declining to the westward; a fact that was verified by subsequent observations.

From the most correct observations that have been made, it would appear that the change in the variation at London, from 1580 to 1657 was 11 deg. 15 min. W., which, at a medium rate, is nearly 9 min. yearly; and from 1657 to 1780, it was 24 deg. 41 min., which, at a mean, is about 11 min. yearly; from 1780 till 1802, the average rate is about 5 min. yearly; since 1802, it has been continually diminishing, at the rate of about 1 min. a-year, and is now scarcely sensible, or, in other words, "it is just on the turn," and will now begin to decline to the east.

On this subject, Dr. Halley was the most zealous person that can be mentioned, on account of his important services, both in endeavouring theoretically to discover the true cause of this phenomena, and in practically rendering assistance to navigators by the construction of his variation chart. He traversed the sea for the purpose of making observations; he collected all that had been made by others; he compared them with his own, and published the result of his labours in the form of a chart, for the use and the safety of mariners. This chart was deservedly received by the public with universal applause, and was exceedingly useful at the time; but from the nature of that variation which it was employed to point out, it gradually became less valuable to the navigator, and in 1745 was almost entirely useless.

To account for the cause of this variation, as we have before hinted, it was supposed by philosophers that a large magnet existed in the heart of the earth, which acted on the magnetic needle, in the same way as a magnetic bar of iron or steel placed in its vicinity. This opinion was originally started by Dr. Gilbert, in his work, "De Magnete," and received and adopted, with some modifications and explanations, by Dr. Halley.

We know, by experiment, that if a magnetic needle be suspended above, or placed by the side of a magnetic bar or globe of iron, so that their centres be perpendicular to each other, the needle will remain in a horizontal, or parallel position with respect to the bar, or globe; but if the north pole of the needle be brought nearer to the south pole of the magnetic body, it will dip down, or incline towards it, and that in proportion as it leaves the centre and approaches the extremity of the bar of iron; the same thing takes place if the south pole of the needle is made to approach the north pole of the magnetised body.

Now, if we suppose, with Dr. Halley, that the large magnetic bar or nucleus in the earth, is so placed that its poles are not exactly in the poles of the world, then both the variation, declination, and inclination may be, in this manner, accounted for. But we now know, from the principles of mechanical philosophy, a science that was then in its infancy—a science which, if it did not owe its origin, owed, at least, its sublimest application to Sir Isaac Newton—a science which he reduced to a system—which was extended and improved by a Maclaurin and a Euler—and which received its perfecting touch from the combined ingenuity of a Lagrange and a Laplace;—I say, we know, from the first principles of this science, that, if any number of bodies are acted upon by one common

principle of attraction, they all tend, or are drawn, towards the centre of this attraction, (or, in the technical language of this science,) towards the resultant of all the forces or powers of attraction of the same kind that exist in the universe.

Thus it is in the solar system, in which the bodies that compose it all tend to the centre of gravity of the system, to the resultant of the numerous forces that bind its parts together; and why may not a similar law take place in a magnetic system? May not the resultant of an immense mass of magnetic matter in the earth, exist at, or near the north pole, so as to produce the variation of the magnetic needle? May not this resultant, acting in a similar way to the electric fluid, produce the opposite magnetism in a point symetrically situated, at or near the south pole? Would not the hypothesis of the grand resultant of a magnetic system account for many other phenomena which are observed?

Dr. Halley at first imagined, that the north pole of the great magnet that existed, or was supposed to exist in the bowels of the earth, was situated near Baffin's Bay, and its south pole in the Indian Ocean, south-west from New Zealand. He, however, found that these positions of the magnetic poles would not generally agree with the positions that the needle assumed in different parts of the world; he, therefore, formed a new hypothesis, *viz.* that the great terrestrial loadstone had four irregular poles, two of which acted with more force than the other two. This is a property which is observed in natural magnets, and which can be induced by experiments in magnetic bars.

On this hypothesis, when the magnetic needle is at a great distance from the two north poles, it is affected so as to be directed in a plane passing through the strongest pole. But if the needle approaches much more to the weakest, the greater vicinity will compensate for the smaller absolute force of the weaker pole, and occasion considerable irregularities. Though this opinion was more conformable to the phenomena actually observed, yet to find the position of these poles, would have been a difficult problem, and Dr. Halley, following the principles of the Newtonian Philosophy, did not rest upon a hypothesis thus unsupported by actual observation, as if no other more correct than it could be formed. Euler, however, did undertake the solution of this difficult problem, and so far succeeded as to venture, at least, to say where two of them were placed in the year 1757, *viz.* one in lat. 76 deg. north, and longitude 96 deg. west from Teneriffe. The south pole in lat. 58 deg. south, and long. 158 deg. west from Teneriffe.

[*To be Continued.*]

VARIOUS COMMUNICATIONS.

A GRAIN-GAGE.

To the Editor of the

GLASGOW MECHANICS' MAGAZINE.

SIR,—I have invented a portable instrument, which, I think, will be of great utility to the Farmer, or Corn-Merchant, when he goes to market to buy or sell grain. It is of the steelyard form, having a beam about 12 inches long, (but made with a joint so as to fold,) and a vessel of

copper, or tin, whose contents is just the 100dth part of a firlot. By filling this vessel with wheat, or other grain, hanging it on the short end of the beam, and poising it, by shifting a moveable-index on the long end, you can determine the weight of a firlot of grain in the short space of half-a-minute. This instrument can be folded up in a case, and put in the pocket. I believe when Farmers go to market, to sell grain by sample, they generally take as much as will fill the vessel; for, even though the wheat were 80 lb. per firlot, it would take little more than 12 ounces to fill the vessel. This instrument is, therefore, I think, well adapted to prevent fraud and deception in the purchase and sale of grain.

I have some other inventions to submit to you at a future period, but, in the meantime, I am,

Your very obedt. servant,

M. P. D.

ON THE ELECTRIC FLUID.

SIR,—The identity of lightning and electricity has been so completely verified by many eminent electricians, that no doubt now remains upon the subject. Independently of the certainty which actual experiment has afforded, the analogous appearances of the two would seem to warrant the conclusion, that the spark from an excited electric, and the discharge of the Leyden phial are nothing but the thunderbolts of heaven in miniature. But the daring genius of Romas and Franklin, not satisfied with conclusions drawn from analogy, prompted them to the means of establishing the truth of this doctrine, upon the satisfactory basis of experiment; and of demonstrating, that the awful phenomena of the thunder storm, are only the effects of an electrical discharge, upon the great scale on which nature operates.

But, if lightning and electricity be perfectly identical, as they certainly are, how is it that lightning is so frequently seen unaccompanied with any noise; though the spark from an electrical-machine is never unattended with a sensible report. I have often reflected upon this subject, but never yet have I satisfied myself as to the cause; neither have I ever heard it discussed by any public lecturer, or met with a satisfactory explanation of it in any work on electricity. I have generally observed this phenomenon in the evening, when the temperature was pretty high, the sky cloudy, with the wind soft and breezy, but unaccompanied with rain; and more frequently in autumn, or in the beginning of winter, than in any other season. That lightning should, in any case, be unattended with thunder, cannot be accounted for upon any of the known laws of electricity, and must depend upon something with which we are imperfectly acquainted. Mere distance cannot, surely, account for this seeming anomaly in nature; for what is distant with regard to one place, cannot be so with regard to every other; and, though the report might not be heard in every place where the flash was seen, yet, if produced at all, it must necessarily be heard somewhere, and intelligence of it would be carried to places which its tremendous voice had failed to reach. It may, however, be urged, that the distance, in this case, consisting in altitude, the thunder is spent before it reaches our earth; and that, consequently, as light

travels to a far greater distance, and with far greater velocity than sound, the flash, from the sudden eruption of the electric fluid, may be often very visible, when the sound which it produces is quite inaudible. To this I would reply, that, at so great an altitude as this supposes, the electric fluid would be under so little atmospheric compression, that, instead of bursting forth in compact and solid masses, forming what is called lightning, it would diffuse itself in all directions, in form of the aurora borealis. But high in the aerial regions as this latter phenomenon takes place, yet even *it* has been sometimes heard to make a flickering kind of noise, not unlike the sound occasioned by a continuous stream of electricity. Besides, it is not obvious that the lightning in the cases above-mentioned, is always any great height. It is often seen bursting from the clouds, when, to all appearance, they are as low as clouds usually are during the most violent thunder-storm. The lightning, it may be observed, is, on these occasions, not of its usual livid hue, but rather of a very pale yellow, and is, for the most part, unattended with that destructive influence, which tracks its progress on other occasions.

If you, Mr. Editor, or any of your numerous correspondents, will be at the trouble of solving my difficulties on this interesting subject, you will have, at least, one grateful reader of your valuable Magazine, in

J. C.

ON VENTILATION.

SIR,—In the communication I sent you last week, I merely took into account *ventilating*, and not *warming* churches. The latter is quite a secondary point; and, in country churches, is seldom thought of. Where, however, it is considered necessary, it may be effected in any of the usual methods, which will not interfere with, but rather assist the former process. Stoves and fires in a church possess the advantage both of ventilating and warming the building; but they cause partial currents, and, unless fed by pipes from without, vitiate the air by absorbing its oxygen. A great inconvenience from them is, that being placed above the level of the floor, they cause a constant rush of cold air to the feet, and hot air to the body. To obviate this inconvenience, the fire ought always to be below the level of the pavement. Where a stove is already used in a church, it would be very easy to employ it for the purpose of ventilation, as well as warmth. Let a pipe, reaching nearly to the ceiling, and open at top, be brought down the side of the building, and bent as before *under* the stove. The stove must be made air-tight, except through this pipe, which has a communication with the body of air in the interior of the building, at or near the ceiling. The fire being lighted, the air will rush up the chimney; but the whole apparatus being air-tight, the place of this rarified air can be supplied, and the fire fed, *only* through the ventilation-pipe, which will thus draw off the vitiated air from the interior of the building, and carry it through the chimney into the open air, while fresh air flows in from every crevice to supply its place. The whole apparatus may be concealed, or rendered ornamental, if necessary.

D.

QUERIES ON OIL GAS.

SIR,—By giving the following Queries on oil gas lighting, a place in your Magazine, you will confer a favour on me, and on many of your country readers.

Your's truly, S. M.

Moffat, 28th Jan. 1824.

1. May oil gas be made with safety, and without producing a disagreeable smell, in a dwelling-house, for the purpose of lighting it?

2. Would an apparatus, constructed on the plan of the miniature one, with which Dr. Fyfe, in the Edinburgh School of Arts, exhibited the method of making oil gas, be best adapted for use in a dwelling-house?

N. B. Dr. Fyfe's apparatus consisted of an iron tube laid obliquely across a chaffer of burning coals; a tin flask of oil was attached to the upper end of the tube, in an inverted position, which communicated with it by a stop-cock, and the lower end of the tube was introduced into the vessel of water in which the gasometer was inverted. When the stop-cock was opened, the oil descended in drops into the tube: in passing the hot part it was decomposed, and the gas ascended into the gasometer, through the water.—*See Scotsman of 22d Jan.* 1824.

3. Are we to conclude, from the experiments of Dr. Fyfe, when he exhibited oil and coal gas together, and compared their lighting powers, purifying only the coal, that oil gas, when simply passed through water, is sufficiently pure for lighting houses?

4. What might be the cost of a good oil gas apparatus, on Dr. Fyfe's plan, to produce 20 cubic feet of gas per night?

QUERY, IN HYDRAULICS.

Edinburgh, 29th Jan. 1824.

Sir,—In erecting a certain work, I have occasion to raise water to the height of 15 feet. I have a fall of 5 feet, from which I can spare a pipe of three-inch bore. The cistern or reservoir to which the water is to be raised, is situated at the distance of 50 yards on the opposite side of a river.

Having seen a description of Montgolfier's Hydraulic Ram in the 4th No. of your Magazine, can any of your ingenious Correspondents inform me of the best mode of effecting the above by that Machine, what quantity of water is likely to reach the cistern, and the probable expense of the apparatus? An early reply will greatly oblige,

Sir, &c. Z. Z.

QUERIES, &c.

1. If a lamp of 10 lb. weight be suspended from the ceiling of a room over a pulley with a counterweight to poise it, the pulley bears the weight of 20 lb.; and if, instead of a counterpoise, the end of the string be fastened to a table, or the floor of the room immediately below the pulley, the pressure of it is exactly the same. But if, instead of being brought down, the string be carried over the pulley, at a right angle, and fastened to the wall of the room, what weight, in that case, does the pulley sustain?—K.

2. What is the best mode of painting transparencies on glass?—C. S.

3. One person can spin a certain quantity of yarn in three days, and another can spin the same quantity in five days, how long will both together take to spin it?—A.

4. How long is it since five Sundays happened in February before, and when will it happen again?—C.

5. Is it possible to sound below a certain depth in the sea?—T.

Edinburgh, 29th Jan. 1824.

Sir,—Your Correspondent 'M.' is incorrect in saying ice is never found on the sea owing to its great depth. If that were the case, it would be frozen to a considerable distance from the shore. No: the reason the sea never freezes, is the attraction of the moon, which causes tide to flow and ebb. In northern climates, the attraction is not so great, which, with the intense cold, causes the sea to freeze. A.

A Correspondent, 'G. M.' suggests the great utility of opening a communication between Miller-Street and Queen-Street, by means of a street or passage through their centre, similar to that between Virginia-Street and Miller-Street. We think a continuation of Wilson-Street even farther than Queen-Street would be a better plan, though perhaps more expensive.

A "Constant Reader" suggests the utility of covering carrier's waggons with waterproof cloth, to prevent the goods being damaged by rain, &c., and states, that the covers should be made with flaps, to let the rain fall off without damaging the lowest pile of goods.

MISCELLANIES.

On the application of Pyroligneous Acid to the Preservation of Ship Timber, &c.

A gentleman of New-York, who has been engaged for several years past in conducting a series of experiments for the preservation of ship timber, has discovered and demonstrated, that the pyroligneous acid is one of the best agents to preserve wood from decomposition by the dry rot and the worm. For this purpose, he took

small pieces of different kinds of wood, green as well as seasoned, and exposed them in a damp place, to the action of warmth and moisture. Those pieces which had been previously saturated with the pyroligneous acid, remained indestructible, while those of the same kind of wood which had not imbibed the acid, went soon to decay by mould and the dry rot. It has been long known that this acid will preserve animal substances from decomposition; but that it will preserve vegetable substances, as timber and planks, has not been so well known, or so fully and generally admitted; though many facts might be stated to prove its efficacy when it has been casually or accidentally applied.

The ease and simplicity of the process, recommend it to the notice of ship-builders, who, it is hoped, will generally adopt it. When seasoned timber or plank are hewn into the intended shape, put them under cover for a week or ten days, to protect them from the rain. During this time, let the acid be applied to the surface daily, by a brush. It will penetrate an inch or more into the substance of the wood, and will be found an effectual preservative. The central part of the wood, or the heart of oak, being less liable to decomposition, will require less of the acid. The frame of the ship or boat may be then put together, when all the external parts of the timber are completely saturated, but not before.

The pyroligneous acid may be applied in a still easier way. Build a house of brick or boards, in or near the ship-yard; let it be of proper dimensions, according to the size of the ship intended to be built. Make it tight, or nearly so. Into this house let the timber and planks, after they are hewn to the requisite size and shape, and properly prepared, be stowed, with suitable dunnage placed between the different sticks. Take any common stove, place it outside the building, and let the pipe enter the side of the building, about a foot and a half from the ground. A fire being made in the stove of small pieces of oak wood, the smoke will enter the house; the room will soon be filled with it, and the timber will readily imbibe the acid. Keep it exposed constantly to the action of smoke for a week; in this time, the external part of the wood will be found saturated with the acid: it will be glazed or coated over with a gummy, resinous substance; the wood will shrink or become consolidated, and will be ready to be framed. By this process, green timber also may be pretty well seasoned in a week. The smoke-house should be detached from other buildings, and carefully watched to prevent accidents by fire.

A ship after she is launched may be fumigated to advantage, by making a fire of oak chips in a stove in the lower hold, and closing the hatches; but this is an imperfect method of using the acid, because it cannot be applied to all the parts of the plank and timber, by reason of their contact and adherence. The smoke, however, if continued a-week, will be extensively applied to the materials which compose the inner surface of the ship, and will contribute much to their duration. The fire must of course be carefully watched by lifting the hatches occasionally.

Green timber, cut in the thick forests of the interior, which is naturally porus and spongy, after being saturated with this acid, will be nearly as good for ships, steam and canal boats, as the Teak wood of the East Indies, or the live oak of our sea coasts.

This process of fumigation is easily applied to water casks, destined for the reception of water during a long voyage. When the staves are trimmed to a proper shape, let them be exposed to the action of smoke for a few days; and then let the hogshead be put together. Hoops made of green wood are particularly subject to the dry rot, if the cask is placed in a damp situation. If saturated with the acid, this will be prevented.

Sail cloth, exposed to the action of smoke for a short time, will be rendered less liable to mill-dew. The pyroligneous acid may be applied advantageously to the wooden materials which compose the roofs of houses; which, being exposed to the alterations of humidity and desiccation, go soon to decay; also to the wooden materials which are used in cellars.

Gun carriages, previously to being painted, should be saturated with the acid which will enable them to endure the weather, without decomposition. The same may be said of carriage wheels to be used on land; and of the wheel work for mills. In short, the pyroligneous acid may be advantageously applied to many sorts of wood-work, which it is needless here to particularize; it being one of the most powerful agents to resist decomposition.

Posts which are intended to be set in the ground, instead of being charred, may

be saturated with this acid, which will render them indestructible. This hint will be useful to farmers. The acid may also be applied to the roots of peach and other fruit trees, as it prevents the worm from attacking them.

If woollen cloths be saturated with this acid, the moths will not consume them, but the colour will be injured. So if paper, previous to being printed, be saturated with this acid, the moths will shun it—the whiteness of the paper will, however, be injured.

Rich and valuable furs are apt to be injured by insects. By being first immersed in the acid, or fumigated sufficiently, the insects will avoid it. The acid is applicable also to raw hides; previously to being put on board ships, they should be well fumigated, to prevent the injury they are apt to receive from insects.

We may congratulate the mercantile and sea-faring part of the community, on this valuable discovery; which, if generally adopted, will be the means of saving life and property, by increasing the strength and durability of ships. It will also tend to diminish the expense of ship-building, and to lessen the rate of insurance.—*New-York Daily Advertiser, Dec.* 24, 1823.

Industry Rewarded.

Sir Edmund Saunders, Lord Chief Justice of the Court of King's Bench, towards the close of the seventeenth century, was originally a strolling beggar about the streets, without parents or relations. He came often to beg scraps at Clement's Inn, where his sprightliness and diligence made the Society desirous to extricate him from his miserable situation. As he appeared desirous to learn to write, one of the attornies fixed a board up at a window, on the top of a staircase, which served him as a desk, and there the beggar boy sat, and wrote, after copies of court, and other hands, in which he at length acquired such expertness, as, in some measure, to set up for himself, and to commence hackney writing. He also took all opportunities of improving himself by reading such books as he could borrow; and in the course of years became an attorney, counsel, and, ultimately, Chief Justice!—*Biog. Dict.*

METALLIC PUNS.

Historical Doubts.—An Auctioneer, at a late sale of antiquities, put up a helmet with the following candid observation:—"This, ladies and gentlemen, is a helmet of Romulus the Roman founder; but whether he was a brass, or an iron founder, I cannot tell."

The Canon of Castile.—A *cannon of cast steel* from Spain, how useful must he have been during the campaign!

MR. CROSS.

This praise-worthy and most ingenious mechanic, whose machine holds such a conspicuous place in our Magazine this week, having met with unmerited neglect, notwithstanding his many essential improvements in loom-work, we consider it as a matter of imperative duty to call upon the Public of Glasgow, and especially upon the manufacturing part of the community, to assist in rescuing him from that poverty and oblivion which long threatened to overwhelm him. In the town of Paisley, some of his Machines are in active operation, and are considered a great blessing to the Operative. We learn, with pleasure, that the Manufacturers of Edinburgh have come forward, with their wonted goodness, and cheerfully offered to support him, by an annual salary nearly adequate to his wants, if he will only reside amongst them, and inspect, occasionally, the results of his own invention. As Mr. Cross is in very bad health, with a young and motherless family, we sincerely hope that Glasgow, which is so much indebted to the improvements which have been made in her Mechanical Arts, will not be behind her rival, in awarding to him, on the present occasion, a remuneration proper for her to give for such an admirable gift to her Manufactures as the Superseding-Draw-boy Weaving Machine. We understand that a Meeting is in contemplation for this purpose, and we trust it will not be delayed. A model of the Machine itself is still exhibiting in Wallace-Court, Bell-Street, Glasgow.

SECOND EDITION.

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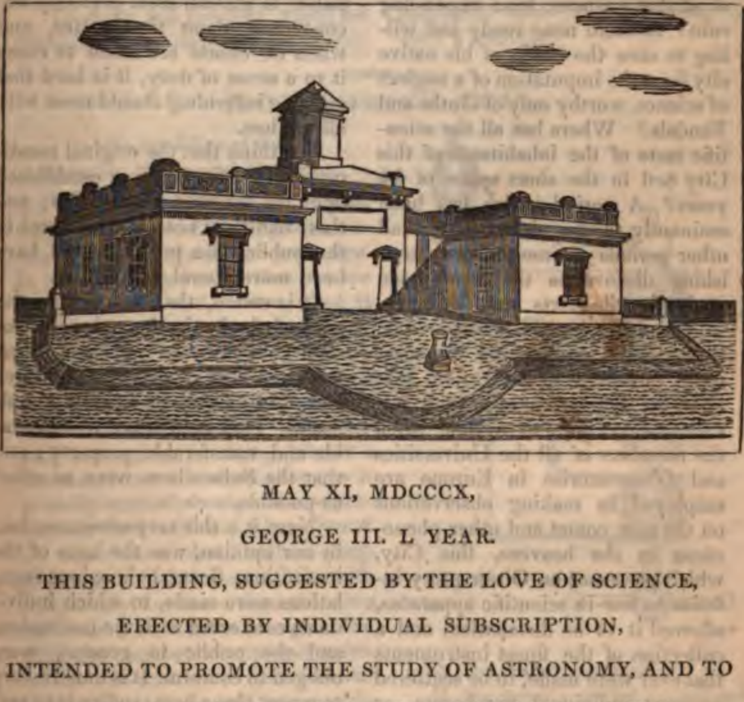
ANDREW YOUNG, PRINTER.

THE GLASGOW
MECHANICS' MAGAZINE.

"Ne'er asks the moon one question; never holds
Least correspondence with a single star."—*Young.*

No. VII. *Saturday, 14th February,* 1824. Price 3*d.*

GLASGOW OBSERVATORY.



MAY XI, MDCCCX,

GEORGE III. L YEAR.

THIS BUILDING, SUGGESTED BY THE LOVE OF SCIENCE,

ERECTED BY INDIVIDUAL SUBSCRIPTION,

INTENDED TO PROMOTE THE STUDY OF ASTRONOMY, AND TO

RECORD OBSERVATIONS THE MOST INTERESTING,

IT IS HOPED WILL LONG REMAIN

APPROPRIATED TO ITS DESTINED OBJECT,

AND A MAGNIFICENT MONUMENT

OF THE SCIENTIFIC TASTE, AND PUBLIC SPIRIT, OF

THE CITY OF GLASGOW,

AND OF THE PRESENT TIMES.

Such is the motto engraven on the plate said to be deposited in the foundation-stone of the Glasgow Observatory. How vain, indeed, are the hopes of man! Within five days, this "magnificent monument of the scientific taste and public spirit of the City of Glasgow" will be sold to the highest bidder.

Is there no wealthy individual ready to come forward and preserve this institution, devoted to the noblest of all the sciences, from impending ruin? Is there none ready and willing to save the credit of his native city from the imputation of a neglect of science, worthy only of Goths and Vandals? Where has all the scientific taste of the inhabitants of this City fled in the short space of 14 years? A period which has been eminently distinguished above all other periods of time for the astonishing discoveries that have been made in the Arts and Sciences.

And shall it be said, at a time when the sciences are making the most rapid advances to perfection, that Glasgow had no share in their advancement? that, at a time when the members of all the Universities and Observatories in Europe are employed in making observations on the new comet and other phenomena in the heavens, this City, which possesses an Observatory inferior to few in scientific apparatus, allowed it to be dismantled, and a collection of the finest instruments that ever were made, to be scattered amongst individual purchasers, or to be laid up in the Macfarlane Observatory?

We really cannot refrain from expressing our astonishment, that no efforts have been made by any of the many *learned* societies and public-spirited bodies that exist in Glasgow, to rescue this institution from the dissolution that awaits it. We understand, that the Mechanics of this City proposed, last year, to purchase all the instruments themselves—so ardent were they in the cause of science, and so unwilling to see such a noble and useful institution fall to ruin. We know that great praise is due to the worthy individual who has the principal share in the property, for his candour, love of science, and willingness to come to any kind of agreement that would preserve it for the use of the public. But when the public in general seem perfectly unconcerned about the matter, and when no efforts are made to rouse it to a sense of duty, it is hard that any one individual should meet with all the loss.

We think that the original constitution of the Society was established upon too contracted principles; and that, had they been more liberal to the public, the public would have been more liberal to them.

It is stated, that, to execute the plan of the institution, three thousand pounds were required. That this sum was raised by a hundred and fifty shares, of twenty pounds each. That each share was heritable and transferable property; and that the Subscribers were as select as possible.

Now, it is this very selectness that, in our opinion, was the bane of the institution. Several obnoxious regulations were made, to which individuals connected with the institution, and the public in general, were obliged to conform. It is unnecessary to repeat these here, suffice it to say, that strangers, from whatever quarter, gained more ready admittance than the inhabitants to whose use it should have been devoted; a circumstance which rendered them callous to the interests of the institution, and at last made them totally regardless whether it flourished or decayed.

What now should be done to re-establish it, is, we think, a question

in which the scientific credit of the City is involved. Let those, therefore, who have any regard for this, now come forward, and lend their assistance to its re-establishment upon a popular basis. Let a public meeting of all the inhabitants who feel interested in the matter, be held in the Trades' Hall immediately; and let those individuals who are able and willing, make a spirited attempt to carry such a praiseworthy object into execution.

To delay this meeting would be fatal—only five days remain before the sale of the whole must take place, by virtue of a sheriff-warrant. If this meeting is not held, it will be matter of regret to many in Glasgow. Indeed, we know one individual, prompted by the love of science and a true feeling of regard for his native City, who came forward, at a former period, and offered a rental for the use of the institution, in order to throw it open to the public, and who is willing to do so again, if no other means can be obtained. Inhabitants, save him the glory of such a sacrifice!

IRON BORING TOOL.

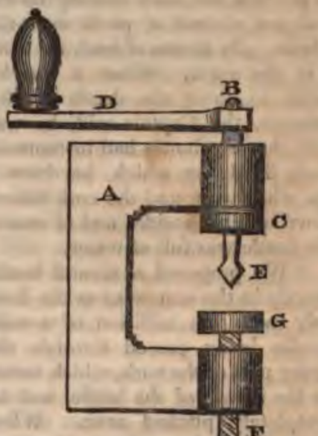
To the Editor of the
GLASGOW MECHANICS' MAGAZINE.

SIR,—I herewith send, for your inspection, a small boring tool, invented by me about six years ago. It was sheer necessity that set me to contrive it; and I have found it to be very useful in many cases, particularly where it was found necessary to pierce iron framing which had been previously fixed near to a wall, or to other framing. It is also very convenient in doing jobs at a distance from the work-shop, as it is easily carried about, and one person can work with it. I have found by experience, that, with a sharp drill, one man can bore a hole with it in nearly the same time that two men can bore a hole of equal size with the common cramp and brace.

The one sent is the first that was made; but I have seen some made since, with this improvement, that the hole which receives the drill is continued out through the opposite end of the spindle; so that the drill may be easily forced out with a small punch, when it is to be sharpened or exchanged. The spindle is made of steel, and the other parts of good malleable iron.

I am, SIR, your's respectfully, M.

Tradeston, 22d Jan. 1824.



A, the frame, or gland.

B, the spindle, with a square hole in the end to receive the drill.

C, a ruff on the spindle, to bear against the frame when in action.

D, the handle, to give motion to the drill.—E, the drill.

F, the screw, to give pressure against the drill.

G, a revolving collar, hollow in the centre, and fixed on the end of the screw, to bear against the article to be bored.

EXPERIMENTS ON THE POROSITY OF GLASS.

To the Editor of the
Glasgow Mechanics' Magazine.

Sir,—In the Rev. John Campbell's *Travels in South Africa*, a singular experiment is related to have been made by the Author in his voyage home to England, which he describes in the following words:

"We drove a cork very tight into an empty bottle—the cork was so large that more than half of it could not be driven into the neck of the bottle. We then tied a cord round the cork, which we also fastened round the neck of the bottle, to prevent the cork sinking down, and put a coat of pitch over the whole. By means of lead, we sunk it in the water. When it was let down to about the depth of fifty fathoms, the Captain said, he was sure that the bottle had instantaneously filled; on which, he drew it up, when we found the cork driven down into the inside, and of course the bottle was full of water.

"We prepared a second bottle exactly in the same way as the first, only with the addition of a sail-needle being passed through the upper part of the cork, which rested on the mouth of the bottle, and all completely pitched over. When about fifty fathoms down, the Captain called out, as before, that he felt, by the *sudden increase* of weight, that the bottle was filled; on which, it was drawn up. We were not a little surprised to find the cork in the same position, and no part of the pitch broken, yet the bottle was *full* of water. None of us could conjecture how the water got in.

"There was no part of the pitch open that would admit the point of a needle. Supposing the pitch and cork both porous, it does not appear easy to account for a quart of water passing so *instantaneously* through so small a space. The *porousness of the glass* seems to be the only consideration by which we can account for the fact."—*Campbell's first Travels*, p. 362.

This singular account having excited some considerable curiosity, and created many doubts as to the correctness of the worthy traveller's inference, that the *porousness of the glass* was the cause of the phenomena which he records, your present Correspondent felt some desire to have the experiment repeated by different persons, and in other circumstances: for were it admitted that glass would become pervious to water, when subjected to a high degree of pressure, yet surely no one will imagine that it would become a sieve, and that an ordinary sized wine-bottle would allow a quart of water to rush through its sides in an *instant*. For then must it run in streams, through pores at least as large as straws, instead of those of indescribable minuteness, which it is obvious the pores of glass must be, if, indeed, it has any at all; besides, to allow the water to pass through, must require time in proportion to their diminutive capacity, and no velocity that is at all credible would allow a quart to pass through the extent of surface which a bottle affords, in any thing like a period that could be called *sudden* or *instantaneous*. Nothing, indeed, in my opinion, short of hours, or days, or weeks, could be calculated upon for such a process.

It is, however, not only stated that the rush of water into the bottle was *sudden*, but that it *filled* the bottle. What then had become of the *air* with which it was previously filled? If the bottle was *full* of water, the air could not remain there in a state of absolute compression; and that it passed through

the pores as the water entered, seems to be contradicted by experiment, which has frequently compressed air in glass vessels, without its ever being known to escape but by the destruction of the vessel. At any rate, it could not pass without a most extraordinary degree of compression; and, if this were the case, how is it that it did not make its way out by forcing up the cork? For it is to be observed, that no power was employed to prevent the expulsion of the cork—all that was attempted was to prevent its being thrust downwards; so that a very small degree of force on the inside, much less, indeed, than that afforded by highly compressed air, would have been abundantly sufficient to have expelled the cork, and have given free admission to the surrounding waters. But nothing of this being apparent, it is demonstrable, that the air could not have been so highly compressed, and therefore could not have passed through the pores of the glass; hence, it is equally clear that the water could not have passed through these pores.

When these reflections at first occurred, an intelligent friend, about to sail for America, was requested to repeat the experiments; which he has done, and kindly communicated the following:—

Experiment 1st. "Took an empty wine-bottle, and simply corked it tight, and sunk it 120 fathoms; it came up full of water, the cork being forced down the neck of the bottle.

Experiment 2d. "Lowered an empty bottle closely corked, tied under and over, together with a piece of sailcloth over all, to prevent the cork from being forced either in or out of the bottle. It filled at 80 fathoms. The cork *appeared* to be unmoved.

Experiment 3d. "Lowered an empty bottle, the cork being tied under and over as before, and covered all over with a thick coat of sealing-wax. The bottle filled at about the same depth; but the cork was forced about half an inch down the neck of the bottle, and the string by which it was tied, was broken.

Experiment 4th. "To prevent the cork from being forced down the neck of the bottle, I placed in it a piece of wood, which reached within an inch of the top of the neck, then corked it down as tight and close as possible, and waxed it over. The bottle filled as before; but the wax appeared to be a *little cracked*. The bottle, each time, seemed to fill instantaneously. The experiments, upon the whole, were *unsatisfactory;* and the only way in which it appears to me possible to demonstrate whether glass is sufficiently porous to admit so much water in so short a time, would be to make the experiment with a bottle having a ground glass stopper, or one hermetically sealed."

The suggestions of this gentleman were adopted; and another friend, going to the island of Ceylon, was provided with bottles hermetically sealed, and with one having a ground stopper, which was proved to be air-tight, by being formerly used to contain gases. The experiments of this friend, after a protracted stay, have just come to hand, and are as follows:—

"The first experiment was made during a perfect calm. The common bottle was corked, leathered, and sealed; and, besides these precautions, a stick was put into the inside, to prevent the cork from descending. The bottles were then lowered about 100 fathoms at least; and when drawn up, the cork was found thrust into the bottle, but the one hermetically sealed came up quite empty. The last time the experiment was tried was just before we made the island of Ceylon. We

then let down a common bottle well corked, a bottle hermetically sealed, and one with a ground stopper, as before. When taken up, the cork was thrust into the common bottle: the bottle hermetically sealed had a flaw in it, for upon its being drawn up, the water burst out through a very small hole, and continued to do so till none was left. The bottle with the ground stopper came up empty.

"These experiments, therefore, did not prove unsatisfactory. There was an advantage attending the circumstance of the bottle hermetically sealed having this very small hole, as it points out the degree of pressure sustained by the bottles at the depth of 90 fathoms; for it was *too small to suffer the air to escape*, and the water could only enter by compressing the air. The bottle was three quarters full of water, so that the pressure was such as to force air of the density of the atmosphere into one quarter of its bulk.

"In a conversation I had with a gentleman of this island, he stated that he had made the experiment with a common wine decanter, or something similar, and that the water penetrated it. But I felt confident that there must have been some flaw in the bottle or the stopper."

This is my friend's opinion; to which, it is presumed, most persons will be inclined to subscribe, though the case is still attended with singular phenomena.

It may be necessary just to remark, that some oversight must have induced my very intelligent friend to make the observation, that the flaw in one of the bottles was too small for the escape of the air; because it is intimated, that when drawn up, a small hole was observed, through which the water was seen to burst forth: and if so, undoubtedly there must have been a passage quite sufficient for the extrication of the internal air: nor does it appear at all probable, that the air should have been compressed into one quarter of its bulk without bursting a cracked bottle to atoms.* The point of advantage obtained by the flaw in this bottle appears to be this, that, with all the assistance of this flaw, the water could not enter with sufficient velocity to *fill* the bottle; but when drawn up, was found to be one-fourth empty.

D. A. N.

Glasgow, 6th Feb. 1824.

* We suspect our correspondent has forgotten the external pressure of the water.

HUMAN PETRIFACTIONS.

By James Rennie, A. M.

Lecturer on Philosophy, London; Editor of the "Quarterly Journal of the Medical Sciences," &c. &c.

To the Editor of the
Glasgow Mechanics' Magazine.

Sir,—As I observe that Geology comes within your plan, permit me to offer you the following fragment.

In former times, we were amused in books of travels with accounts of gigantic human bones being found in various parts—demonstrating, as was thought, that the former race of men were greatly taller than the present. We cannot indeed question that there were men of great stature in ancient times, as we have for this the undoubted testimony of Scripture; but the stature of the Egyptian mummies, which is rather over than under the present stand-

ard, proves, that, at least 3000 years ago, (the supposed date of the mummies,) all men were not gigantic. The gigantic *human* bones of our marvel-seeking travellers, have turned out to be the bones of the antediluvian elephant, rhinoceros, &c., and we must look elsewhere for human remains.

If it be true, as it appears probable from the masterly work of Granville Penn, that the first continents, with the men who lived on them, are now at the bottom of the present sea, and that our present continents were the channel of the sea before the deluge,—it accounts at once for the want of human remains now found in the earth, or enclosed in rocks. The only exceptions to this, yet known, are the human skeletons found embedded in the limestone rocks of Guadaloupe. Two only of these skeletons are known. The one is in the British Museum, and is thought to be a female: I have repeatedly examined it. The other has been received at Paris within the last few months.

"At the peace, M. Donzelot, the governor of Guadaloupe, was ordered by the French Government to send home this interesting specimen, which is, according to the description of Cuvier, more perfect than the one in the British Museum. It wants the skull, but the greater part of the upper jaw, with some teeth, is preserved. The rest of the skeleton is in a bent position—almost that of a semicircle. It was quite hidden or buried in the limestone rock; but the bones had suffered no change, possessing their animal jelly perfect, and also their inflammability. The rock in which this human skeleton is embedded, contains, besides, well preserved specimens of both the sea and land shells still common in the island." The shells prove that the skeleton is modern, or, at least, has been embedded since, and not before, the flood of Noah; for *no* petrified shells of more ancient date agree, as these do, with the shells now found in a fresh state. The reasoning which might be gone into, on this subject, would for the present be too prolix for your pages, and would take more time than I can now spare, immersed as I am in the bustle of a London literary winter. With my heartiest wishes for your success,

I am, &c. J. RENNIE.

London, 30th Jan. 1824.

ON THE MAGNETIC NEEDLE.

[Continued from page 89.]

Diurnal Variation.

BESIDES the *secular* variation, the magnetic needle is subject to a *diurnal* variation. This was first discovered by Graham, in 1722, and reported by him to the Royal Society. It afterwards occupied the attention of Canton, who, in 1759, made a series of observations which enabled him to ascertain results for the different hours of the day, and also for the different months of the year, which may be called the *monthly* variation. He constructed a table showing the average of the greatest daily change of position in the different months in the year, which has been verified by subsequent observers, though it varies in different places of the globe.

The law of the daily variation has also been determined, and it is found that the needle advances progressively during the morning towards the west, till it attains its maximum, about 2 P. M., it then returns again towards the east during the evening; and in this way it

continually revolves; and the result of the revolution is, that the sum of the motions toward the west exceeds the sum of the motions toward the east, and, consequently, its increase of declination is westerly.

Now, to account for all the phenomena of the magnetic needle, *viz.* the declination, the inclination or dip, the monthly variation, the diurnal variation, &c., we would once more advert to the supposition, that there may exist somewhere a resultant of all the magnetic matter or attraction that exists in the universe.

Perhaps, as we have said before, there may be a point near the north pole of the world, through which the resultant of all the magnetic forces in the earth does pass, and to which, consequently, they must all be attracted. The supposition that this point is not exactly in the pole of the earth, should account for the variation of the compass, and also for the variation in the dip or inclination of the magnetic needle; and the supposition that this point will produce a contrary magnetism in a point symmetrically situated near the south pole, will account for similar variations of the needle when placed near this pole of the world.

But, to extend our theory a little farther, let us suppose that the power of magnetism may exist in the moon. And what is there to hinder such a supposition? Is not the moon a body like our earth, though much smaller in dimensions? Do we not see mountains, and vallies, and seas, and volcanoes, in the moon, all indicating that it is formed of a mass of matter similar to our earth? May not iron, and magnetic iron ore, exist in the bowels of the moon? May not her inhabitants be just now employed, as we are, in exploring the causes of gravitation, electricity, galvanism, and magnetism? May not some lunatic philosopher have lately been struck with the singular phenomenon, the variation of the magnetic needle on the surface of his globe? But we forbear.

Granting, however, the postulate, that magnetism does exist in the moon, may not the magnetism of the earth be affected by that of the moon? And may not the possible circumstance that the poles of the earth and moon attract each other, account for the daily and monthly variations of the needle? And if this attraction varies according to some function of the distance, may not the revolution of the earth on her axis, account for the diurnal variation, inasmuch as it will change the place of the magnetic poles of the earth and moon in respect of each other, and the more so, if we take into account the possible magnetic attraction of the sun and other bodies in the system?

For since we have supposed the moon to be possessed of magnetism, it would be unphilosophical to deny it to the other planets, and to the sun himself. Nay; who knows but that the sun may be the centre of our magnetic system, as well as of our system of gravitation? the great magnetic pole, to which all other poles in the solar system are attracted, may possibly exist at, or near the pole of the sun, and, consequently, may affect the magnetism of all the bodies in the system. We confess, that the similarity between the attraction of magnetism, and the attraction of gravitation, appears to us so strong, and so likely to account for the various phenomena of the magnetic needle, that we think the subject ought to be considered by those who have leisure and ability to make the necessary experiments.—Our readers will find some interesting experiments on magnetism among our Miscellanies.

THE PRINCIPLES OF NATURAL, OR MECHANICAL PHILOSOPHY.

No. V.

We have often thought, that, by a proper arrangement of the principles of Mechanics, this science might be assimilated to the elements of Geometry. We have accordingly attempted, in what follows, to arrange some of the leading principles necessary to the demonstration of the parallelogram of forces, after the manner of Euclid. This being the fundamental proposition in the doctrine of forces, it is proper to establish it, before advancing to the numerous applications of which it is susceptible.

Axiom 1.*

Equal and contrary forces destroy each other's effects.

Axiom 2.

Forces acting in the same straight line, and not contrary to each other, produce the same effect as a force equal to their sum.

Axiom 3.

If two forces act, neither in the same nor in contrary directions, in the same straight line, they must act in two lines forming an angle.

Postulate 1.†

That a force may be found equivalent to two or more forces acting in any direction; the former being denominated the Resultant, the latter the Composants.

Postulate 2.

That a force may be resolved into two or more forces acting in any directions, and equivalent to it.

Postulate 3.

That a force may be supposed to act at any point in the line of its application, or direction.

* A self-evident truth.

† Something that must be granted.

Lemma 1.*

If two forces act in lines of direction forming any angle, they will produce an effect.

For, if they do not, (Ax. 1,) then they will be equal and contrary forces, which is against the hypothesis: therefore, they must produce an effect.—Q. E. D.†

Lemma 2.

The direction of the Resultant must lie between the lines of direction of the Composants, that is in the angle formed by them.

For, if not, the direction of the Resultant must lie in the direction of one or other of the Composants; but, whatever reason may be assigned for its direction in the one, may be also assigned for its direction in the other; hence, the Resultant may have two different directions at once, which is absurd; therefore its direction must lie between those of the Composants, that is, in the angle formed by them.—Q. E. D.

Lemma 3.

The Resultant must lie in the plane of the Composants.

For, whatever reason may be assigned to show that its direction will be in a line above the plane of the Composants, may be also assigned to show that the direction will be in a line symmetrically situated below the plane; hence, the Resultant will be both above and

* A proposition laid down to simplify those that follow.

† *Quod erat demonstrandum.* Which was to be demonstrated.

below the plane at the same time, which is absurd. Therefore, the Resultant, &c.—Q. E. D.

Corollary 1.*

If the forces are equal, the direction of the Resultant must bisect the angle formed by that of the Composants.

For, whatever reason may be assigned to show that the Resultant will pass through any point situated on one side of the bisecting line, the same reason may be assigned to show that it will pass through a point symmetrically situated on the other side; hence the Resultant may pass through two different directions at once, which is absurd. Hence, the direction of the Resultant cannot be in any other line than that which bisects the angle.—Q. E. D.

Corollary 2.

If the forces are unequal, the direction of the Resultant will be nearer to the greater force than to the less; that is, the angle formed by the direction of the greater force with that of the Resultant, will be less than the angle formed by the less force with the Resultant.

[*To be Continued.*]

* An inference.

LETTERS, QUERIES, &c.

HINTS TO MECHANICS.

To the Editor of the
Glasgow Mechanics' Magazine.

Sir,—Being an enthusiastic labourer in the pursuits of science, every moment of my time is taken up, and were my life of antediluvian extent, I would find employment for it all. The plan I adopt in prosecuting my investigations, I purpose laying before you on some future occasion, and shall only, at present, enforce the utility of every Artist keeping a pencil and note-book always in his pocket. I have myself found the greatest advantage from this; hints occur in a moment, and are apt as speedily to be lost; one hint, too, often suggests another, and when the mind is occupied in contemplating the advantages or applications of the second object, the original suggestion, and the train of reasoning which gave rise to it, are forgot. A word or two in the note-book, will be sufficient to recall the hint and its uses. Even to the purely scientific gentleman, this help to the memory must be of great advantage, but to the Mechanic and Artist it must be of still greater. The sudden hurries of business to which they are exposed, may preclude the possibility of giving a practical attention to their note-book for several days, or even weeks. I might also recommend, that each alternate page of the note-book be left blank, to receive, as leisure permits, the results of the investigations. In a week or two, I shall have the pleasure to send you an extract from my note-book, which has now accumulated to more than one hundred volumes, in case the plan I adopt should be approved of by any of your numerous readers.

Before concluding, I have an observation to make in the way of censure, which I hope will be taken in good part by those to whom it may apply, and that they will suppose me solely actuated by a zeal for the scientific glory of my native country. Your correspondents must be aware, that periodicals are of two

the one scientific, the other ; or, I might say, the one is for instruction, and the other usement; the first then is to contain facts, and the exon of them: and the latter, is occupied with a mixture of hing but fiction, generally has -eminent sway. From this stance, it is always allowed e scientific magazine is the nportant; and as it is made of reference, it is necessary information should be au- . This leads me to suggest priety of each of your corrests inclosing with his first nication, (for your private tion of the authenticity of sent,) his name and address. the information which the w Mechanics' Magazine so widely around amongst rative class of society would doubly valuable.

re been led to this hint, from er of hasty assertions which advertently crept into your and from a number of plas from other works, which f your correspondents have led to you as original. Of st, I shall select but one e. At page 62, one D. M. ou, as his own, "A cheap f making a Barometer;" now, he simple alteration of not an three words, this will be n the "London Register of d Sciences," for 29th Novem-823, page 60, where the says it is copied from the newspaper; in the same you will find the queries, you had supposed, added by ; and there also, at page 61 , you have the phenomena heap barometer explained.

e the hint I have taken the to give, adopted by your ondents, none of these incones would occur.

In conclusion, I beg you to understand, I do not object to correspondents culling from other works for your readers; so far from it, I am fully satisfied that it is the duty of all those who wish well to the arts of their country, to draw from every source, as it were, into a scientific focus, whatever is useful to those actually employed in the Arts; but let us acknowledge the source from which we copy our information, and not assume it as our own.

I remain, your's, respectfully,

I. D.

Edinburgh, 8th Feb., 1824.

The hints thrown out by our ingenious Correspondent are, in our opinion, truly valuable, and highly worthy the attention of our readers and correspondents. We think his criticism is, in general, quite just, and proper to be observed. But we think he is rather too severe upon D. M. We never supposed his communication on the barometer to be original; in fact, we have said that it "has appeared several times in the public prints."

We anticipate, however, some excellent articles from our critical friend, who seems to be imbued with an enthusiastic spirit in the cause of science, that is highly creditable.

On the CREATION of LIGHT.

Sir,—Permit me to offer a few observations, in answer to D. A. N.'s query, (see No. III. of the Magazine.)

The account of the creation, given in the first chapter of Genesis, evidently relates to the earth considered as the habitation of man. It is probable that the other bodies composing the solar system, are coeval with the earth, and that the laws by which their motions are regulated, were impressed on these bodies immediately on their being called into existence —the moon at this time being in conjunction, or in the position where she is styled new moon.

This being premised, verse 2d con-

tains a general description of the earth's surface. On the creation of light, (verse 3d,) or, what is now considered the cause of it, *viz.* the luminous atmosphere of the sun; the succession of day and night (verse 4th,) commenced, and it is remarked (verse 5th,) that the evening and the morning, or, one revolution of the earth on its axis, was the first day: the evening being the time that elapsed between the creation of the solar system and the sun's atmosphere.

At this period, for want of the earth's atmosphere, the sun might not be visible. But, passing this opinion, it may be assumed, with confidence, that, in the absence of the atmospheric pressure, the waters would exhale, or vaporize in such quantities, as to prevent the sun's rays from penetrating to the surface of the globe; while, at the same time, being under the influence of gravitation, they would be prevented from flying into space.

The firmament, (verses 6th, 7th, and 8th,) expansion, or atmosphere, was next created; which, separating the exhaled waters from the general mass, and causing them to ascend, supported them in the form of clouds; the earth now had performed another revolution on its axis, and all that was external with regard to it was completed.

By the close of the third day, (verses 9th, 10th, 11th, 12th, and 13th,) the land was separated from the water, and the vegetable kingdom created; and the earth thus fitted for the reception of the animated creation. Hitherto, the direct rays of the sun were unnecessary, and the moon, from her proximity to the sun, was invisible. But, to mark, as it were, the vast importance and utility of these luminaries, as well as to direct the attention of mankind, in a peculiar manner, to the unmeasured beneficence of the Almighty Creator, as manifested in these his greatest natural gifts, on the fourth day, (verses 14th, 15th, 16th, 17th and 18th,) the clouds were dispersed, and (the moon being now three days old) the "lights in the firmament of Heaven" shone forth in all their beauty and splendour, and were appointed not only "to divide the day from the night," but also "to be for signs and for seasons, and for days and for years," until the time which they measure be no more.

In further elucidation of the above view, it may be remarked, that, when the crude mass of the earth was created, it contained all the elements of the succeeding creations; and these followed in *perfect continuity*. HE who is excellent in working, and to whom day and night are equal, is perfect in all his ways. The very sequence of the work is most natural and beautiful—the creation of the earth—of light—of the atmosphere—the gathering together of the waters—the production of the vegetable kingdom—the appointment of the seasons, &c., suggest a train of the most interesting reflections, but which your space forbids me entering on.

Although the view taken in No. 4, by T. W. and yourself, differs essentially from the above, yet I beg leave to refer your readers to these excellent articles; as in putting together the above remarks, I have been more concise, in some places, than I would have been had they not preceded mine.

In conclusion, the verb in the sentence—"Let there be light," &c. (in the 14th verse,) in the original is not in the imperative, but in the future tense; and, as there is no present tense in the Hebrew language, (this deficiency, I believe, being generally supplied by the future,) these words might be rendered, "Let there be lights manifested," &c., or, "Let the lights," &c. This translation, too, agrees best with the scope of the whole passage; which, it must be observed, insists chiefly on the uses, not on the creation, of the sun and moon. And, further, if we compare, attentively, the passages contained in verses 3d to 5th, and 14th to 18th, it will be obvious, that the former considers light *created*, so as to produce the phenomena of day and night; while the latter contemplates the particular *means* employed to produce these as well as other phenomena. Compare, particularly, verses 3d and 4th, with verses 16th and 18th.

M. • N.

Greenock, 3d Feb., 1824.

ON LOCH NESS.

SIR,—In your fifth Number you have inserted my answer to the query, Why Loch Ness never freezes?—and in same Number, a Correspondent in Paisley, under the signature G., has given a new theory, which, you are pleased to say, is plausible.

G., however, labours under an obvious mistake, for he says the water of Loch Ness once heated, and rising up-

it, can then have a communication he colder water beneath—this is nder; for the heated water being tact with the colder water beneath, gradually deprived of its caloric, oth become of the same tempera- nd precisely on the same princi- t cooling goes on. The immense of Loch Ness in the bowels of the at least 2500 feet below the level sea, and the temperature of the being about 50 deg. Fahrenheit, oubtedly, the source from which ters of Loch Ness keep such an temperature, any heating, or cool- its surface amounting almost to g; and there is not the least indi- either by the smell, or the taste, e waters of Loch Ness are affected itical strata. This doctrine was by the late Professor Anderson, years ago.

I am, Sir,

Your most obedient servant.

J. P.

—The cause of Loch Ness not be- zen is correctly stated by J. P. to ng to its extraordinary depth; for jections thrown out by G. must when we consider that the stra- posed to the action of the atmos- is so small, compared to the great f the Loch, that long before it can the bottom, the caloric it had the surface is restored by the r mass below, and its descent ar- And though this appears to re- he temperature of the whole mass, it is not the case, for it must be cted, that the severest frost never ated beyond the depth of a few to the earth, which is again melted ort time; and as caloric always to an equilibrium, what is lost by ter is immediately supplied by the thus, it will be found that all deep continue, at a certain depth, of a m temperature throughout the Should the explanation I have oured to give of this fact, be un- ctory to your readers, by consult- r. Ure's Dictionary, article "Cli- " I doubt not they will be con- l.

I am, Sir,

Your's, &c.

W. C.

n Dock, Feb. 3, 1824.

ON THE CHEAP BAROMETER.

Near Glasgow, 3d Feb. 1824.

SIR,—I suspended three of the barometers, described in No. IV. of your Magazine, on little frames, with a platform under their mouth, to show if a drop fell from them. They were placed in different situations, two in a dwelling house, with no fire in the apartments, and one in a work-shop; the lower surface of the water, in each, assumed various degrees of convexity and concavity, but they were seldom all alike; one would have been convex, another concave, and a third even with the neck of the phial, at the same time.

I looked, in vain, during the space of eight or nine months, for a drop of water falling from any of them, and yet the water disappeared. What, then, became of the water—and how got air into the phial? The water was evaporated slowly from its lower surface, until it assumed a pretty lengthened concave figure. When the vacuum was thus increased in the phial, above the water, the sides of the cone then came together, and inclosed a bubble of air, which ascended through the water, supplied the vacuum with air, and the water instantly assumed a convex figure below; I happened to observe this process, after long watching. Now, here two extremes in the figure of the lower surface of the water took place, in the twinkling of an eye, from arid drought to rain, or its close approach, according to D. M.'s *probatum est*.

I must acknowledge, however, that to my weak capacity, it showed a total absence of the properties of a barometer, but a fine specimen of the means which Nature employs to keep peace in her family.

As it is by mere chance that one can see the above process going on, an experiment which I made to-day, with the enclosed phial, (although it has rather a wide neck,) will give a good idea of it. Fill the phial only half-full of water, for the more air there is in the phial, the experiment will be quicker; invert it, and hold it steadily in the hand. The heat of the hand will expand the air within the phial, and allow a drop or two of water to fall; hang it up in a cool place, and a concave surface will soon be formed below, and extend, till a bubble of air be inclosed, and ascend through the water, as before noticed.

The necessity for cutting off the rim

of the phial, arises, I apprehend, from another cause than that assigned by Y., in No. V. Phials have a smooth, and, generally, a sort of bell-mouth; this furnishes a sort of inclined plane for the water to steal away, as it were, from the action of the atmosphere. It appears to be the sharp areas produced by cutting off the rim which is the turning point in the case. You will see that the fracture of the phial I have sent, is far from being even, or at right angles with the body of the phial, which is what I understand Y. to mean by a perfectly level surface; and though the neck is wide in proportion to the phial, it carried water many months.

Wishing you every success in your undertaking,

I am, &c.

A Mechanic.

Answers to W. G.'s Queries, by a Glasgow Mechanic.

1. ON NEAR-SIGHTEDNESS.

In all persons that are extremely fair-haired, and white-skinned, there is either a deficiency in the quantity, or a derangement in the quality; or, (speaking technically,) a morbid secretion of the colouring matter of the skin, and of the black pigment (Pigmentum Nigrum) of the eye, a black or darkish looking substance, that completely overspreads that delicate expansion of the optic nerve, the retina, and acts as a shade to it, and prevents the too strong action of the rays of light from deranging its fine organisation.

If this *Pigmentum Nigrum* is either deficient in quantity, or too transparent in its nature, to act as a proper and sufficient shade, there will, in such cases, be a proportionate contraction of the pupils, in order to prevent too strong a glare of light striking upon the retina, and in proportion as the pupil is contracted, the distance of vision will be lessened.

It is from this cause that the Albinos, or Leuco-Æthiopians, take their strange peculiarity. In their case, there is probably a total want of the *Pigmentum Nigrum*, and, from the exceeding vascularity of the iris, in the completely transparent eye, the peculiar *red* appearance arises.

The colour of the eyes of white rabbits, white mice, owls, sparrows, &c., arises from the same causes; and, if a person will look clearly into the eyes of one of these animals, he will distinctly see the manner in which the objects are *inverted*.

2. ON LAUDANUM.

The first, and most effectual means of counteracting the effects of laudanum, is the emptying of the stomach; for which purpose the patient should be made to swallow from fifteen grains to a scruple of *Sulphate of Zinc*, or from five to ten grains of *Sulphate of Copper*, dissolved in water; and the vomiting should be kept up for a considerable time, and urged by irritation of the fauses.

When vomiting cannot be properly produced, in consequence of the paralyzed state of the nervous system, the cold bath has been said to restore the energy of the brain, and thus to render the person susceptible of the stimulus of an *Emetic*. Blood-letting, under some circumstances, is highly extolled. When this is resorted to, the jugular vein is preferred, from the more immediate relief it gives to conjestion of the brain. Should these means fail, it has been proposed, by an eminent physician, *M. Orfila*, that one or two grains of *Tartarized Antimony*, dissolved in one or two ounces of water, should be injected into the veins.

It was formerly proposed, by *Boerhaave*, to empty the stomach of its poisonous contents by means of a syringe; which operation, we see, has been successfully tried by Sir Astley Cooper, in his late Surgical Lectures. Vinegar, and vegetable acids, were long considered an antidote to opium; but the experiments of *M. Orfila* have clearly proved, that, so long as any portion of the opium is in the stomach, these, so far from doing good, considerably aggravate the symptoms produced by this *Narcotic*, in consequence of the power they possess of dissolving it.

When, however, the opium has been expelled by vomiting, these acid drinks have the property of diminishing the concretive symptoms. The powers of the habit should, at the same time, be supported by brandy, strong coffee, and cordials, and the sufferer, should, if possible, be kept awake, and in a gentle motion. *Dr. Currie* recommends that warm water, at 106 or 108 degrees, should be poured on the person to remove the stupor.

SIR,—It would oblige a mechanic, if any of your Correspondents would give the cost of a five, ten, or twenty-horse steam power, house and machinery.—And, what it will cost to keep it in working order, for a term of five, ten, or twenty years.

If it comes within the range of any one of your Correspondents' knowledge, he would oblige me by stating the cost of a water-power of five, ten, or twenty horse power; with tear and wear for a period of five, ten, or twenty years, including the expense of the dam and lade.

It would also be a favour to inform the writer hereof, the real weight of a steam-power of five, ten, or twenty horse power, including the boiler.

I am, Sir,
Your's truly,
A MECHANIC.

Glasgow, 5th Feb. 1824.

Answer to A.'s Question in our last.

SIR,—Let a be the time the one person takes to perform the work; b, the time the other takes; and x, the time they both take. Then $\frac{1}{a}$ is the part of the work performed in one unit of the time by the one, $\frac{1}{b}$ by the other, and $\frac{1}{x}$ by both. Hence $\frac{1}{a}+\frac{1}{b}=\frac{1}{x}$, and by multiplying this equation by a, b, and x, respectively, we have $ax + bx = ab$, or $(a + b)\ x = ab$, and consequently $x=\frac{a\,b}{a+b}$.

Whence the general rule, *Divide the product of the two times by their sum, the quotient is the time required in which both, working together, will perform the work.* Thus we find the answer to A.'s question is $1\frac{7}{8}$ days.

W.

Four Correspondents inform us, that five Sundays will happen again in the February of 1852. W. A., A., and W. J. state that it happened before, in 1784, and the two latter refer us to MR. Boaz's Bill Card for 148 years. M. M. R. states, that it happened in 1796, and that it will happen every twenty-eighth year, or every seventh leap-year, which is contrary to the aforesaid Bill Card.

QUERIES, &c.

Edinburgh, 4th Feb. 1824.

1. When the dark part of the new moon is faintly visible, or, (as the saying is,) when the old moon is seen in the new moon's arms—why do we augur bad weather? and, What is the cause of this phenomenon?—J.

2. Is there any method of rendering a bladder permanently soft and pliant, like chamois skin, or worn linen, without destroying its property of holding such fluids or gases as it does in its natural, or dry state?—What is the process, and what animal's bladder is best suited for it?—G. M.

3. Mm. wishes to know the manner of exhibiting some natural movements of figures to be seen through a magic lantern.

MISCELLANIES.

Results of some experiments lately made with a Magnetimeter, or new instrument for measuring the magnetic attraction, and dip, or inclination of the needle.—BY J. SCORESBY, Jun. F. R. S. E. &c.

1.—Iron bars become magnetic by position, excepting when placed in the plane of the magnetic equator; the upper end as regards the position of the magnetic equator, becoming a south pole, and the lower, a north pole.

2.—No attraction, or repulsion, appears between a magnetised needle and iron bars; the latter being free from permanent magnetism whenever the iron is in the plane of the magnetic equator; consequently, by measuring the angle of no-attraction, in a bar placed north and south, we discover the magnetic dip.

3.—Before a magnet can attract iron that is totally free from both permanent and positionary magnetism, it infuses into the iron a magnetism of contrary polarity to that of the attracting pole.

4.—A bar of soft iron, held in any position except in the plane of the magnetic equator, may be rendered magnetical by a blow with a hammer, or other hard substance; in such cases, the magnetism of position seems to be fixed in it, so as to give it a permanent polarity.

5.—An iron bar, with permanent polarity, when placed any where in the

plane of the magnetic equator, may be deprived of its magnetism by a blow.

6.—Iron is rendered magnetic if scowered or filed, bent or twisted, when in the position of the magnetic axis, or near this position; the upper end becoming a south pole, and the lower end a north pole; but the magnetism is destroyed by the same means, if the bar be held in the plane of the magnetic equator.

7.—Iron heated to redness, and quenched in water, in a vertical position, becomes magnetic; the upper end gaining south polarity, and the lower end north.

8.—Hot iron receives more magnetism of position than the same when cold.

9.—A bar magnet, if hammered, when in a vertical position, or in the position of the magnetic axis, has its power increased, if the south pole be upward, and loses some of its magnetism if its north end be upward.

10.—A bar of soft steel, without magnetic virtue, has magnetism of position fixed in it, by hammering it when in a vertical position; and loses its magnetism by being struck when in the plane of the magnetic equator.

11.—An electrical discharge made to pass through a bar of iron devoid of magnetism, when nearly in the position of the magnetic axis, renders the bar magnetic; the upper end becoming a south pole, and the lower end a north pole; but the discharge does not produce any polarity, if the iron be placed in the plane of the magnetic equator. The effects appear to be the same, whether the discharge be made in the lower, or upper end of the bar, or whether it is passed longitudinally or transversely through the iron.—*Ed. Phil. Jour.*

We are informed that our townsman, James Cook, Esq. Engineer, is at present making a new steam-boiler, with flews, after the manner of those used in steam boats, to be presented to Anderson's Institution. It is to be mounted on a carriage with wheels, for the more easily moving it from one part of the building to another after use. It is as large, we believe, as will supply all the engine-models of the Institution at one time; whereby the student will be gratified with a view of the whole, from those of Newcomen and Savery, to the latest improvement, as the locomotive, &c. Such a complete set of working models is rarely, if ever, to be met with in any Institution but itself.

We hear that a very useful Compendium of Practical Mechanics, by a Glasgow Mechanic, will appear next week.

NOTICES TO CORRESPONDENTS.

We have already too many unanswered queries, of more importance than those proposed by W. B.; we wish he would employ himself in answering some of them, instead of proposing new ones.—'Dr. Hornbook' sent a 'school-boy's' solution. C. a wrong one. J. O. a common one. B. a very good one; but his question cannot be inserted, as we have too many of the kind.—M., of Paisley, says four days is the time which both persons would take to spin the same quantity.—B., of Kilmarnock, is too severe; we only excuse the style, not the language; his reasoning, too, is very illogical.—'A Plain Kintra Man' seems to be in jest.—In answer to M. T. we reply, that the premium will be given for the best drawings of the latest improvements, before the end of this year.—'A Friend to Science' in Greenock, has hit upon a subject in which we are much interested, and which we shall notice in due time.—A. must be deferred.—'An Observer' under consideration.—We are sorry that we cannot insert R.'s communication consistently with our plan. Other Correspondents will be answered next week.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement, which is the subject of their notice.

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THE GLASGOW
MECHANICS' MAGAZINE.

"Thus birds for others build the downy nest;
Thus sheep for others bear the fleecy vest;
Thus bees collect for others honey'd food;
Thus ploughs the patient ox for others' good."

No. VIII. *Saturday, 21st February,* 1824. Price 3*d.*

PATENT POWER LOOM.

Fig. 1.

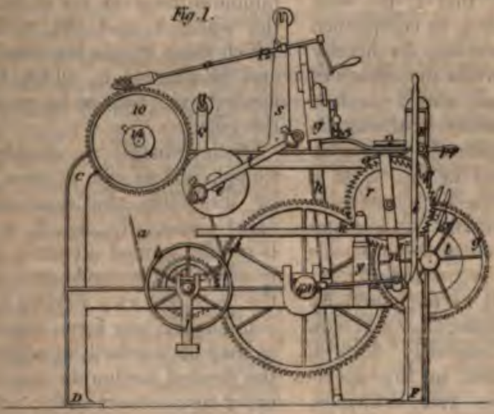
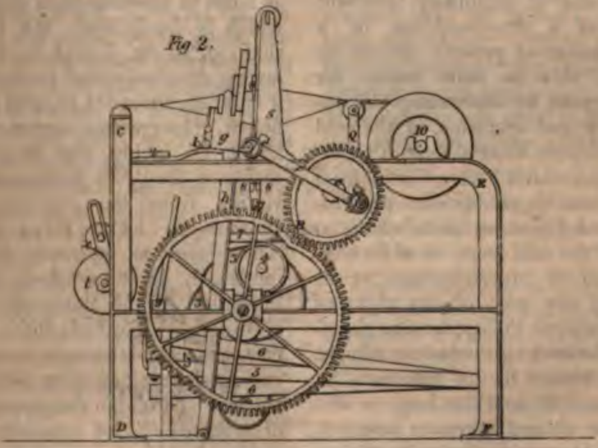


Fig 2.



PATENT POWER LOOM.

ABSTRACT *of the Specification by* ARCHIBALD BUCHANAN, *Esq. of Catrine Cotton-works, one of the Partners of the House of James Finlay & Company, of an Improvement in the Construction of Weaving-Looms, impelled by machinery, whereby a greater quantity of Cloth may be woven in a given time, without injury to the fabric, than by any application of power for that purpose heretofore employed.*

NOW, KNOW YE, that I, the said Archibald Buchanan, in compliance with the said proviso, do hereby describe and ascertain the nature of my said invention; and I declare that the same consists in the application of two eccentric wheels, A and B, represented in fig. 2, to a weaving-loom, impelled by machinery, as represented in fig. 1 and 2; and that the application of these wheels to the said loom is particularly exhibited by fig. 2; as explained by the description herein after set forth. But I, farther, expressly declare, that while I refer, in my specification, to these two drawings, fig. 1 and 2, exhibiting different views of a weaving-loom, of a construction at present in use by myself, this is done solely for the purpose of illustrating the application and operation of the said two eccentric wheels upon a weaving-loom, which I have found, from experience, to produce the best effect; and I protest, that I claim no part of the said loom, or of its construction as my invention, or as forming any part of my right of patent, except the application thereto of the said two eccentric wheels.

A reference to the drawings, in fig. 1 and 2, and the key, or description thereof, hereunto annexed, will enable any person of ordinary mechanical skill, to understand and execute the application and operation of the said two eccentric wheels, either to the loom of the construction which I employ, or by slight alterations, which will be obviously suggested, to the ordinary weaving-looms, at present in use by the public. The lay, *g*, attached to the rod, *h*, vibrating upon its centres below, is connected with the eccentric wheel, B, by means of the crank-rods, at F. This wheel, or pinion B, receives its motion from the wheel A, and the method by which these wheels are constructed, and the manner in which they are applied, are now to be particularly described.

Both wheels, as already mentioned, and as will, at once, appear by inspecting the drawings, and, more particularly, fig. 2, are what is usually termed eccentric—that is to say, their circumferences, in which the teeth are cut, deviate from the common circular form, in such ratio as may be required, in order to give the desired motion to the lay. In order to construct such a wheel, A, as I use in weaving plain cloth, and which is fixed upon the treadle-shaft, *q*, in fig. 1 and 2, the following description and explanations, if carefully attended to, will be sufficient. Its greatest diameter being about 19 inches, and its smallest diameter about 16 inches—its deviation from the circular form amounts to about three inches. This deviation, however, may be increased, or diminished, at the discretion of the constructor, and according to the variation of velocity which he wishes to communicate to the reciprocating motion of the lay. To obtain the proper curve of eccentricity, let two concentric circles be drawn, corresponding with the greatest and smallest diameters. Divide these circles into any convenient number of equal

parts; as, for example, 64, and draw radii from the centre to the points of division in the external circle. Divide the space between the circles into the same number of equal parts with the circumference, one of which being set off upon the first radius, two upon the second, and so on progressively, until the whole are set off, points will be obtained through which a curved line being drawn, the required form of the circumferences will be marked off upon each quadrant of the wheel. The highest points, as will appear by the drawings, are, at the two extremities of a diameter line, bisecting the external circle, and the lowest points, at the extremities of another diameter line, bisecting the internal circle at right angles to the former. Thus, the form obtained, bears some resemblance to an ellipse, with its conjugate and transverse diameters. The pinion, B, must, of course, be constructed so as to correspond with, and work into the wheel, A. To effect this, it is merely necessary to draw circles as in the former case, corresponding with the greatest and the smallest diameters required. Then set off one half of the radii drawn upon the wheel, A, the pinion being half its diameter, and add, progressively, to each radius of the pinion, as many equal parts as were taken from each corresponding radius of the wheel, and *vice versa*. The semidiameter of the pinion will thus correspond, in every point, with each quadrant of the wheel, and the pinion will revolve twice whilst the wheel performs one revolution as before stated—thus communicating two accelerated strokes to the lay, for each revolution of the treadle-shaft moving the wheel, A. The circumferential forms of both being thus obtained, the teeth are to be cut and rounded off, so as to work properly into each other in revolving upon their respective axes. Though the wheel, A, will thus produce two revolutions of the pinion, B, other proportions may be adopted when deemed expedient, and as may suit the motions to be communicated to a greater number of treadles for weaving plain, tweeled, or figured cloths. Those conversant with the art of weaving, will at once perceive, that a varied speed, applied to the reciprocating motion of the lay, is of the greatest advantage, and such as will keep the lay as nearly stationary as convenient at the point where the shuttle is thrown across the web; and when the shed, or divided portions of warp are sufficiently open to allow the shuttle to pass without injury to the warp threads. The lay, in returning, drives up the woof to the fell, or verge of the cloth, with a smart stroke, whilst the shed, or divided portions of warp are closing upon it, and when the least tension is given by the treadles to the warp threads. I have ascertained, by experience, that in looms having such wheels, and the other apparatus before described attached to them, the shuttle may be thrown across a web, 36 inches wide, 130 times per minute, without creating more breakage, in proportion to the quantity woven, than occurs in looms driven at the rate of 80 to 90 crossings of the shuttle per minute. *

Description of the Drawings referred to in the prefixed Specification.

The construction of the wheels, A, B, upon the application of which the patent is claimed, is delineated on the drawing, fig. 2.

* We understand that the patentee of this most important invention has himself driven the shuttle across the web 160 times per minute, without injury to the cloth, a speed which is nearly *double* of that of the looms at present in use.

Fig. 1 and 2 exhibit the two end views of the loom. In the following description the same letters of the alphabet, and numerals, denote the same things in all the figures.

C, D, E, F, denote the frame.—*a*, the strap, communicating motion to the loom, at *b*.—*b*, the fast-and-loose pullies.—*c*, a pinion fixed on the end of the pulley-spindle, and working into the wheel *d*, of triple the diameter, gives motion to the wiper-shaft, *q*. (See fig. 1.)—*k*, the lever and fork—and *l*, the spring for engaging and disengaging the loom, at pleasure. (See fig. 1.)—A lever is connected with the protecting-pin of the lay, 2, for disengaging the loom, should the shuttle remain in the shed.—*m*, a small eccentric wheel, fixed on the end of the wiper-shaft, *q*, (see fig. 1,) and connected with the lever, *n*, (see fig. 1,) on the top of which is jointed a circular piece of iron, *o*, (see fig. 1,) which acts on the ratchet-wheel, *r*, and draws up the cloth as it is woven; and for varying the fabric in thickness, a ratchet-wheel of more or fewer teeth is applied.—*p* is a catch, bent in the same manner as *o*, which prevents the ratchet wheel, *r*, from returning back. By raising the handle, *p p*, these catches are all disengaged. Behind the ratchet-wheel, *r*, is fixed a small pinion working into the wheel, which is fixed on the end of the cloth-beam, *t*. (See fig. 1.) The beam, *t*, is covered with a card-fillet for holding the cloth.—*x*, is a small roll, which receives the cloth from the beam *t*, and round which it is wound, by the motion of the beam, *t*.—*e*, the crank-shaft which receives motion from the wiper-shaft, *q*, by the wheels, A and B.—*f*, the connecting-bar.—*g*, the lay.—*h*, the lay-sword. (See fig. 1 and 2.)—S the heddle-roll bearer. (See fig. 1 and 2.)—Q the yarn-roll bearer. (See fig. 1 and 2.)—11 the yarn-roll. (See fig. 1 and 2.)—14 a screw-box. (See fig. 1.)—1 is the protecting catch, for disengaging the loom when the shuttle stops in the shed; this catch is connected with a rod passing along the lay, on which the shuttle-springs in the boxes act; when the shuttle fails to enter the box, this catch falls down, and striking against the pin, 2, the lay is held fast, and the loom instantly disengaged by its connexion with the lever which acts on the handle of the loom, *b*. (See fig. 1 and 2.)—3 3, the heddle-wipers, which, by acting on the friction pullies, fixed to the treadles, *b b*, alternately elevate and depress the treadles. (See fig. 2.)—7 7, the short marches connecting the heddles, 8 8 8 8, with the treadles, 6 6. (See fig. 2.)—4 4, friction-pullies, fixed to the heddle-wipers, 3 3, acting alternately on the treadles, 5 5, to which the picking-peg, *q*, for throwing the shuttle, is connected by bolts and screws.—10 is the warp-yarn beam. (See fig. 2.)—A, B, the eccentric wheels for giving motion to the lay, *g*. (See fig. 2.)—*y*, the bearer of the bolt-fork *k*, and which extends so as to connect another loom. (See fig. 1.)—14 the friction wheel; its appendages are two plates fastened to the beam-shaft, and upon one of them is glued a piece of leather, which is made perfectly flat by turning, the face of one of the appendage-wheels is also turned flat, but this wheel is loose on the spindle; on the outside of it is the screw-box, 14, the outer part of which is made fast to the beam-shaft, by a pin passed through it, the inner part of the box is then screwed up against the outer face of the said wheel, which presses the two surfaces together, and any degree of tension can be given to the warp-yarn by more or less screwing of

the box, 14. (See fig. 1.) There is a small pinching screw-pin which is screwed into the outer box, the point of which enters a small cavity in the inner part of the box, and prevents it from unscrewing.—17, the long heddle marches connected to the heddles, 8, by cords, and to the short marches, 7 7, by wires. (See fig. 2.)—*j*, the bearer of the pulley-shaft. (See fig. 1.)

ON THE PROCESS FOR DISCHARGING TURKEY-RED.

In our first Number, we abridged, from that highly respectable Work, the *Journal of Science and Art*, an account of the discharging process of Turkey-red by means of presses, according to the arrangement adopted by Messrs. Henry Monteith & Co. This process, considered as the means of introducing the Turkey-red dye to an immense extent; as the cause of a greatly increased consumpt in the articles of cotton-cloth, soap, soda, oils, bleaching-powder, with many others; and as a source of greatly increased revenue, has proved of incalculable importance to this country. We think, therefore, that we shall at once afford gratification to our Readers, and only perform a piece of common justice to a highly meritorious individual, in stating to whom the country is indebted, for this important invention.

This merit belongs to Mr. John Miller, now in the employment of Messrs. Charles Macintosh & Co. He completed his invention in the year 1802.

Like all other great inventions, his has the merit of simplicity. So great, however, was the feat considered at the time, that printers from the Continent visited this country, in the hope of ascertaining the process; and so impracticable was it considered, that a popular preacher of the day was heard to refer to Turkey-red, in illustration of the scarlet of the Jews, mentioned in Holy Writ, as a colour which no human means could whiten.

Hargreave, the inventor of the hand-jenny, which contributed so much to the advancement and prosperity of the manufactures of this country, was allowed to live poor and neglected; and died, to leave his age the reproach of (for that neglect) the present; which, nevertheless, is content to bequeath to posterity the name of Miller, to be a similar reproach on itself. It ought to be known, that, notwithstanding the wealth which individuals and the country have gained by his invention, this meritorious individual, distinguished as much by his worth as by his talent, possessing an extent of practical knowledge in his favourite art that is rarely to be met with, and, at more than sixty years of age, carrying into the pursuit of it all the enthusiasm of youth, has never obtained profit from his invention, nor reward, nor even thanks,

"The easiest recompense,—how due!"

Instances of such neglect are unhappily not limited either in number or kind, or to any age or clime.

Who does not recollect the case of poor Robert Burns? Flattered, it is true, and, for the gratification of their own vanity, dined by the great, he was yet allowed to live in penury; till, when he had died, and when his fame was seen to roll down time, in a stream that was not likely soon to dry up, the rich bethought themselves, and erected an imitation of a Heathen Temple,

to echo back the voice of the poor ploughman's fame, and to sound forth that of their own Christian beneficence. Surely, surely, we think, it was to Jews and Heathens, and not to Christians, that the appeal was addressed, "What man is there of you, whom if his son ask *bread*, will give him *a stone?*"

Nor are instances wanting of the ancient date of such neglect. "There was," says Solomon, "a little city, and few men within it; and there came a great king against it, and besieged it, and built great bulwarks against it. Now, there was found in it A POOR WISE MAN, and HE, by his wisdom, DELIVERED THE CITY; YET *no man remembered* THAT SAME POOR MAN."

Conduct like this, so preposterous, but yet so common, grins a Satire on the race. But, however common the imputation may be, it is one from which the wise and the virtuous of every age and country will be anxious to keep themselves free.

In contemplating the case of Mr. Miller, there is one alleviating circumstance, to which we feel pride in referring. His wakeful and persevering ingenuity has lately produced a new modification of the discharging process of Turkey-red, which surpasses any that has yet been attempted in the art, and which, we trust, will be the means of obtaining, from the interest of individuals, that reward which generosity should, long ere now, have bestowed on his merits.

The style of work which is the object of Mr. Miller's new invention is what is technically called the *Two-red Bandana;* and his process has the recommendations of being more economical; of preserving the whites, consequently of admitting combinations of the two reds with any variety of *fast* colours, as well as that of affording a pale red, which is much better fixed, and which, we find on comparison, possesses a greater degree of brightness, than can be attained by any process at present employed by printers. We cannot pretend to be acquainted with Mr. Miller's new process; but the opinion of experienced printers, who have examined his specimens, warrants us in the conjecture, that a chief feature in his invention consists in a peculiar mode which he possesses of discharging the *mordant* of the Turkey-red.

It is well known, that the style of combining Turkey-red with other colours, which is so much practised on the Continent, and which is secured by a patent in this country, consists of a union of the most fixed colours, with others the most fugitive. On account of the fugitive nature of these colours, this beautiful style of printing is rapidly becoming unpopular on the Continent. There cannot be a doubt, therefore, that Mr. Miller's new process, which admits of not only the reds, but of all the other colours, being fast, must be of great importance to those individuals who may acquire the possession of it, and to the country at large.

LIFE OF ARCHIMEDES.

THERE is, perhaps, no species of writing that exercises upon the mind of the reader, a greater practical influence of a beneficial kind, than the biography of men, eminent for their talents, or distinguished by their virtues. The qualities which we admire in the abstract, this sort of composition sets before us in an embodied form; and a description

of the excellencies of the dead, affects us almost as sensibly as an actual survey of the living. From these considerations, we were determined from the commencement of our work, occasionally to enrich our pages with the lives of some of those distinguished characters, whose labours in science and philosophy, have immortalized their own names, and conferred signal benefit upon mankind; and, in performing this part of our duty, we hope to meet with the approbation of a numerous class of our readers.

Of all the illustrious individuals, whose deeds adorn the annals of science, few, at least of a remote period, have a greater claim upon the attention and admiration of the mechanic and the geometrician, than he whose name stands at the head of this article. The antiquity of the age in which he flourished, and the imperfect state of biography at that period, have rendered the materials for the composition of his history, extremely scanty. So many notices of him, however, are found scattered up and down in the pages of ancient writers, as demonstrate the high opinion which was entertained at the time he lived, and for long after, of his talents and performances; and as have tended to relieve his biographers of subsequent periods, from the uncertainty of mere conjecture.

This extraordinary man was a native of Syracuse, a city of Sicily; and, according to the most authentic accounts, was born about 288 years before the birth of our Saviour, and about 50, though some say 100 years, after the much-famed Euclid. Who his parents were, and what was their rank in life, are not particularly known; though it is, on all hands, acknowledged, that he was paternally related to Hiero, then king of Syracuse. It is said that Hiero considered himself greatly honoured by such relation; and there can be no doubt, that royalty has more cause to boast its alliance to genius, than genius to be elated by its connection with royalty. It is probable that the name of the monarch, would have been long ago sunk in oblivion, had not that of the philosopher served to float it along the stream of time to the present day. By whom he was instructed in the elements of education, and what was his progress, history fails to inform us: but it tells us, that he became early and ardently attached to the study of mechanics and geometry; and that, for the sake of these tranquil pursuits, he contemned the prospect of wealth and honour, which was presented to his view by his connection with monarchy. The beauty of mathematical demonstration, and the great efficacy of mechanical power, had, for his mind, more charms, than the glitter of courts, or the conquering of cities and provinces.

After studying at home, probably till he had exhausted all the scientific knowledge which the place could afford him, he repaired, according to the prevailing custom of the age, to Egypt, that he might more successfully prosecute in Alexandria, what he had so happily begun in Syracuse. Egypt, if not the birth place of the sciences, was at least the place where, at that time, they were most effectively taught; and was the great theatre of learning, to which persons from all quarters, but particularly from the different provinces of Greece, regularly resorted. We are unhappily left in the dark, with regard to the length of time he remained in Egypt; but we are informed, that during his stay he applied with assiduity to his favourite studies, and distinguished himself by some singular inventions. During his residence upon the banks of the Nile, he enjoyed the society and

friendship of some of the most distinguished characters of his day, but especially of Conon, a famous mathematician of the island of Samos. Their friendship being founded upon their love of science, the most disinterested of all friendships, without the appearance of the slightest jealousy, they had a mutual esteem for each other's talents and attainments, and often submitted problems to each other for solution. Having enriched his mind with the intellectual treasures of Egypt, he at length revisited the land of his nativity, that his countrymen might share in the fruits of his exertions.

Some of the most ardent admirers of Archimedes, have maintained, that he imparted to the Egyptians, as much as he received from them; but this is nothing but mere assumption, and, therefore, entitled to little attention. Whatever benefits he conferred upon the Egyptians, there can be no doubt, that the people of that country were, long before that period, in possession of arts and inventions, which had enabled them to accomplish works, which, with all our modern improvements in mechanics, might not a little try the skill of the present day.

Archimedes, after his return to his native city, is said to have relaxed neither the vigour of his pursuit after knowledge, nor the intensity of his application. His studies were the engrossing objects of all his thoughts. He not unfrequently prosecuted them to the almost total neglect of his person, and food and sleep were often sacrificed to the perfecting of some mechanical invention, or the solution of some difficult problem. To prevent the ruin of his health, his servants were sometimes obliged to interpose physical strength, in order to compel him to recruit his exhausted system, by air, exercise, and the use of the bath. His devotion to the study of mechanics stands almost without a parallel. Hiero at one time expressing his admiration of some of his inventions, Archimedes replied, with enthusiasm, "that he required but a place to fix his machines upon, to be able to move the earth itself."

Thus passed the days of this wonderful man in the peaceful bowers of philosophic seclusion, till the safety of his native city, drew him from his retirement, and prompted him to engage in its defence. During the protracted struggles between the Romans and the Carthaginians, the Sicilians, and especially the Syracusans, had remained for a long time, either neutral, or in alliance with the Romans. At length, from some political movements in the city, the Carthaginian interest gained the ascendancy, and attempts were made to extend it over the rest of the island. So soon as the news of this reached Marcellus, the Roman general, he hastened with a strong force into Sicily, and after having reduced several other places to subjection, he determined to lay siege to Syracuse. Here the successful career of the Roman conqueror met with an unexpected check. The inventive genius of Archimedes, enabled the Syracusans to baffle all the efforts of the besiegers, for the space of three years. Never before was so happily illustrated the admirable sentiment, that "Knowledge is power." He so improved the warlike instruments for the discharge of missiles, as to spread consternation and dismay throughout the enemy, who were more than once, on the point of retiring from the siege, believing that the city was defended by the gods. By means of long and powerful levers, together with grappling irons,

he is said to have destroyed many of the Roman galleys, when they approached the walls of the city; and when they retired for safety, to a greater distance, to have inflamed them by a particular combination of burning glasses. The reports of these achievements of Archimedes having been transmitted to us chiefly by the Romans themselves, there is no doubt that the difficulty they felt in reducing the city, caused them to magnify the obstacles which he opposed to their success, in order that no impeachment might be brought against their courage. But whatever allowance may be made for exaggeration, it cannot be doubted, that science and art gained a noble triumph on this occasion.

The city, if it could have been taken at all, might, it is said, have resisted the assaults of the enemy for a much longer time, had not the success of the besieged lulled them into a fatal security.

During the celebration of a festival in honour of Diana, in the midst of their indulgencies, overlooking the safety of the city, they neglected to place guards on some particular part of the walls; and the Romans observing this, and taking advantage of the supineness of their adversaries, scaled the ramparts, and quickly made themselves masters of part of the city. Their chief difficulties being now surmounted, after a few vigorous efforts, they gained possession of the whole city. Amidst the plunder and carnage which ensued, sad to relate! Archimedes did not escape, though orders had been given by the Roman general for his safety and protection. Various accounts are given of the circumstances of his death, though they all agree in ascribing the merit of this horrid deed to a Roman soldier. Some say, that he was slain in his study, while engaged in solving a problem, in consequence of his hesitating to obey the imperative command of a soldier to accompany him to Marcellus, till he had completed its solution. Others say, that he was put to death in the street, while he was drawing mathematical figures in the sand. A third report states, that he met his unhappy fate, while bearing some boxes of mathematical instruments to Marcellus, and that the perpetrator did the deed without knowing who he was, persuaded that the boxes contained some valuable treasure. This mournful event happened about 210 years before the Christian era, and when Archimedes, notwithstanding his intense application to study, had reached the advanced age of 75 or 76.

Marcellus was inconsolable at this event; and, to make all the reparation in his power, he sought out his relatives, and distinguished them by every mark of attention. The Roman paid the last debt of nature to the remains of him whose loss he deplored, and erected on his tomb a monumental stone, with a suitable inscription, and some figures engraved upon it, emblemative of his discoveries as a geometrician.

C. R.

[A few remarks on some of the principal inventions and discoveries of Archimedes, to be given in our next.]

ORIGIN OF THE GLOBE.

To the Editor of the
GLASGOW MECHANICS' MAGAZINE.

SIR,—In the third Number of your valuable publication, I observe, what is termed, "An Analysis of Mr. M'Fadyen's Introductory Lecture on Natural History," "from a Correspondent," at which Lecture,

although I had not the pleasure of being present, I have little doubt, from the talents of Mr. M'F., was entitled to all the encomium of your Correspondent. But, Sir, in speaking of the remarks on the antediluvian period of the globe, he states, in the shape of a quotation, a paragraph, which, I must confess, appears rather unintelligible; the ideas may be "beautiful," although, I am afraid, they are, at the same time, not a little *fanciful.*

The passage to which I allude, begins thus:—"This carries us back to the infancy of our planet, when chaos and darkness brooded over all, and our continents and loftiest mountains were still covered by the waters." Again, "those days of solitude and desolation, when nature was the prey of contending elements, &c.; when the Polypi, and the imperfectly organized products of the ocean, were the only living inhabitants of the *globe.* And at a later period, when *continents* began to rise, and their *exposed surfaces* to be covered with the *first verdure of vegetation*, and the primeval forests of early ages—when the deep silence of nature was first broken by the voice of the majestic Mastodon," &c. This is a description of the *ante-antediluvian* period, if it may be so called, for, in conclusion, he says, (in regard to the then state of things) "but which at length *perished* in the great revolution (the creation of the world, I presume,) which preceded the creation of our race."

Here, it seems, was a *progressive* state of nature, previous to the act of Omnipotence, which commanded the formation of our globe. Certain elements, by an *inherent principle of action*, gradually developed themselves, and assumed the form of a globe, or something like a globe; "continents began to rise, and their exposed surfaces to be covered with the first verdure of vegetation," &c. Moreover, it seems there were *living creatures*, "the majestic Mastodon, and the nightly Mammoth, which, for a season, were lords of all." These, also, it must be presumed, sprang into existence from the same self-acting chaotic principles.

To be sure, a great *revolution*—great indeed—for it was no less than the *creation* of the world, overturned this globe, or semi-globe, for the elements, he informs us, had assumed some such form, the construction of which, would, according to every principle of rationality, as much have required the agency of Almighty Power, as that beautiful structure we now behold. But what does the only record on the subject, say? "The earth was *without form*, and *void*, and darkness was upon the face of the deep, and the Spirit of God moved upon the face of the waters." No one can infer, that there were here any such thing as "*continents*," with "exposed surfaces;" far less, that there was vegetation; and more ridiculous is it still, to talk of *living creatures* lording these dark domains. The earth "*was without form*, and *void*." The inference is, that it was so, *from eternity*, and remained in this state, *till immediately preceding the creation.* We are not informed, that the Almighty, *prior* to this act, prepared, by any process, the matter which composes it; and to insinuate that this matter, *of itself*, possessed such an innate principle, and had, in reality, *partially* assumed any tangible shape, is to set up a doctrine, in my opinion, inconsistent with our established system of belief. Such ideas, if inspired history is to form the criterion of our inquiries, are quite irrational, or something worse; they may exist in a heated imagination, but never can in fact, or in reason.

It would at once be conceded,

that Mr. M'Fadyen's observations on this topic, were merely the innocent effusions of a strong mind giving way to itself, unfettered, *for a season*, by historical truth, were it not for the existence of a certain very dangerous theory, to the doctrines of which, I, with all due submission, fancy I can perceive such a resemblance in the passage alluded to, as seems to be very objectionable. I refer, in plain language, to the sapient advocates of blind chance—to those who, in the plenitude of their wisdom, perceive such a singular principle in matter, as to enable it to assume the form of a globe, animals, water, and dry land; or, it may be, to throw itself back into a chaos of disorganized and shapeless elements, without at all requiring the agency of a presiding primary Power.

It is trusted, however, that the imputation of such principles attaching to the respectable gentleman in question, has no place, and that his language was mere figure, although in the investigation of truth, such language cannot be avoided with too much caution.

I am, Sir,

Your most obedt.

An Observer.

Glasgow, 30th Jan. 1824.

ON ELECTRO-MAGNETISM.

The first experiments, of any consequence, on the connexion of magnetism and electricity, were made by Professor Ritter of Jena, and communicated by him to the Royal Academy of Sciences at Munich. He first observed, that a magnetic wire and another not magnetic, excited galvanic palpitation in frogs. He afterwards published the following results.

1. That every magnet is equivalent to a pair of heterogenous metals united together; its different poles representing different metals.

2. Like these, it gives electricity; one pole positive, and the other negative.

3. A certain number of magnets produced electricity in such a degree, that the electricities afforded by the poles of different magnets were successfully indicated by the electrometer.

4. Such a battery produces voltaic effects in dead and living bodies.

5. The *south* pole of *magnets* gives positive electricity; the contrary pole negative.

6. In this view of electro-magnetism, the earth, considered as an immense magnet, may be supposed to account for the many electrical phenomena of the earth and atmosphere; such as aurora borealis, &c.

Although these results have been objected to, as doubtful, and have not been received among the magnetic laws, yet a most intimate connection has been recently discovered, and satisfactorily proved to exist, between electricity and magnetism, by M. Oersted, Secretary of the Royal Society of Copenhagen.*

Several philosophers, it appears, in making experiments, some years ago, with the magnetic needle, when placed in the open galvanic circuit, were not successful in finding either sympathy or influence; but Oersted, placing the needle near a wire connected with the

* Investigator.—XII.

opposite extremities of a galvanic apparatus, and rendering the circle complete, found that the magnetic needle was greatly disturbed. The effect, however, was found to be various, according as the relative position of the needle, and the connecting wire was changed. Thus, when the connecting wire was placed in the magnetic meridian, and directly above the compass-needle, consequently parallel to it, the effect was very considerable,—*the pole nearest to the negative end of the battery being moved to the westward;* but when the uniting wire was placed below the compass, *the pole that was nearest the negative end of the battery moved to the eastward.*

It was at first imagined, that an effect was produced by the nature of the uniting wire, but Oersted found that the phenomena were altogether uninfluenced by it; wires of platina, gold, silver, brass, iron, plates of lead and tin, and even mercury, being employed in the experiments with the same success. Neither did the uniting wire lose its effect, when interrupted by water, unless the interruption amounted to several inches in length. He also found that the action of the uniting wire might be transmitted, without any diminution of its effects, through glass, metals, wood, water, rosin, earthenware and stones. And that, when these various substances were interposed at the same time, they scarcely seemed to diminish the effect.

M. Oersted likewise observed, "that the electro-magnetic effects do not depend upon the intensity of the electricity, but solely on its quantity. A plate of zinc, of six inches square, introduced into a vessel of copper, containing the dilute acid, (the conducting fluid he usually employed, consisted of pure water, containing 1-60th of its weight of sulphuric acid, and a similar quantity of nitric acid,) produces a considerable electro-magnetic effect; but when the plate has a hundred square inches of surface, it acts upon the needle with such force, that the effect upon it is sensible at the distance of three feet. He conceived the effect was diminished, rather than increased, when forty troughs, similar to the single one, are united in the battery."

Oersted's first law of electro-magnetic effects is this:—"When opposite electrical powers meet under circumstances which offer resistance, they are subjected to a new form of action, and, in this state, they act upon the magnetic needle in such a manner, that positive electricity repels the south, and attracts the north pole of the compass; and negative electricity repels the north, and attracts the south pole; but the direction followed by the electrical powers in this state, is not a right line, but a spiral one, turning from the left hand to the right."

Our limits will not allow us to indulge in such copious extracts from this interesting paper as we feel inclined to give, but compel us merely to notice some of the most interesting results of the investigations pursued regarding it by M. Ampere, Biot, Buch, Von Buch, Sir H. Davy, Mr. Farass, and others.

When the conducting wire is formed into a helix,* its electro-magnetic properties are greatly augmented, and the phenomena varied according as the helix turns to the right hand, or towards the left; and according as the position of either the galvanic apparatus, or the conducting wire is changed. Thus, a compass-needle introduced within a helix, which is connected with a pair of plates placed in an east and

* Spiral.

west position, the copper west, experiences a contrary deviation from what occurs if the position of the plates be inverted, so as to bring the copper towards the east. And the phenomena of a right helix, as to the direction of the deviation, are, in general, the reverse of those with a left helix.

Since the magnet is not affected by any bodies but such as are magnetic, it was reasonably inferred, that the conducting wire which attracted or repelled magnetic needles, must be, itself, magnetic. This inference seems to have been made, and investigations founded upon it taken up, about the same time, both by M. Arago and Sir H. Davy. Both these philosophers discovered that the conducting wire had not only the power of acting on bodies already magnetised, "but that it was, itself, capable of developing magnetism in iron that had not previously been magnetised."

Sir H. Davy was equally successful in developing magnetic properties by electricity. He fastened bars of steel, two inches long, transversely, to a wire of silver, of 1-20th of an inch, and passed through it the discharge of an electrical battery of 17 square feet, highly charged, by which the steel bars were rendered "so magnetic as to enable them to attract small pieces of steel-wire, or needles; and the effect was communicated to a distance of five inches, above or below, or laterally, from the wire, through water or thick plates of glass, or metal electrically insulated."

Striking as these phenomena are, they are found to be greatly augmented by the employment of a spiral conductor. M. M. Ampere and Arago having wrapped needles in paper, (or in glass tubes,) and placed them within a helix, found them strongly magnetised in a few minutes. Whenever a right helix was used, they found that the end of the needle, towards the negative end of the battery, pointed to the north, and with the left helix, towards the south.

The experiments of Arago on the magnetising of steel, both by galvanism and electricity, like those of Sir H. Davy, by which they were closely followed, were very important, as completely identifying voltaic and common electricity.

Von Buch, applying the augmenting power of the spiral as a conductor to an electrical machine of two disks, of 18 inches diameter, found, that in merely taking sparks from the extremity of the spiral, one turn of the machine was sufficient to render a needle within the spiral evidently magnetic.

The next discovery in electro-magnetism, which we shall merely mention, is that of a kind of polarity and direction in electro-magnetic apparatus.

Another discovery in electro-magnetism, very nearly connected with the above, is that of the attraction and repulsion of conducting wires, or, (assuming the fact of electro-magnetic currents,) the attraction and repulsion of these currents.

We are indebted to M. Ampere for the discovery of the fact, that the phenomena of attraction and repulsion, shown by the magnetic needle when near the conducting wire, can also be illustrated by the mutual attractions and repulsions of other conducting wires. Instead of going into the detail of his investigations, we shall merely state his general results, which he himself gives as follows:—

1. "That two electrical currents attract when they move parallel to each other, and in the same direction; and repel when they move parallel to each other in contrary directions." That is, two parallel conducting wires, connected with

the same poles of a galvanic apparatus, and in the same direction, attract each other if they are parallel; but, connected with different poles, they repel.

2. That when the metallic wires traversed by these currents can only turn in parallel planes, each of the currents tend to direct the other into a situation into which it shall be parallel, and in the same direction.

3. That these attractions and repulsions are entirely different from the ordinary electrical attractions and repulsions.

These laws Ampere derived by regular induction from the effects exhibited on a great variety of apparatus, ingeniously contrived and beautifully executed. A particular account of his apparatus and researches is given in different Numbers of the *Edinburgh Philosophical Journal* for 1821.

Sir Humphrey Davy, in continuing his experiments on the subject of electro-magnetism, has recently obtained several results on the effect of temperature on the conducting wires in diminishing or increasing the magnetic effects; which results are of considerable consequence to the practical magnetician.

One experiment may be mentioned, namely, the discovery of the attraction and repulsion of electrical flame by the magnet; a fact, which is not merely a matter of curiosity, but illustrates, in a new way, the mutual influences of the electrical and magnetical currents. Having charged "the great battery of the London Institution, consisting of 2000 double plates of zinc and copper, with a mixture of 1168 parts of water, 108 parts of nitrous acid, and 25 parts of sulphuric acid, the poles were connected by charcoal, so as to make an arc or column of electrical light," from one to four inches in length. To this arc or column of light a powerful magnet was presented, by which it "was attracted or repelled with a rotatory motion, or made to revolve, according to the different positions of the poles."

Such is the general view of electro-magnetism.

Excepting the researches of Sir H. Davy, and a few insulated experiments by Farraday and others, little else has been done in Britain towards the elucidation of this important subject: the greater mass of information yet communicated to the world, being the result of foreign investigation. Sir H. Davy, in some of his experiments, has been anticipated by foreign philosophers; but, as regards propriety of arrangement, acuteness in conducting the experiments, a decision of the results, and the peculiar clearness and precision of the details which he has given to the public, he has not been exceeded, if equalled, by any of the philosophers who have embarked in this new and interesting field of research.*

* In Volume XV. of "Nicholson's Journal," and in the "Annals of Philosophy" for 1821-22, the reader will find many useful and ingenious views on this subject.

PROCEEDINGS OF THE GLASGOW MECHANICS' INSTITUTION.

On Thursday evening, the 18th current, at eight o'clock, a general meeting extraordinary of the *Glasgow Mechanics' Institution* took place, for the purpose of considering the laws by which the Institution is governed.

The President having taken the Chair, the Treasurer of the Institution, in an eloquent speech, introduced the business of the meeting. He referred first to some reports which had gone abroad, attributing a want of harmony to the Committee among themselves, and towards the Lecturers of the Institution.

These reports, he said, were so unfounded, that nothing but harmony prevailed in the Committee, both among themselves and towards the Lecturers.

In proceeding to explain the immediate cause of the present meeting, he stated, that when the laws had first been framed, the Institution consisted of only about 400 members; whereas, it now consisted of above 1000. Both on account of this increase, and because it was proper that every member should be well acquainted with the regulations of the Institution, it had been thought expedient to give the members an opportunity of hearing the regulations, and of making amendments on them, if that should be judged necessary. The propriety of this had become the stronger, since other similar institutions had applied to them for their regulations. For these reasons, he moved that the regulations be read, first altogether, and then one by one, for the consideration of the meeting. This motion being seconded, and unanimously carried, the regulations were read accordingly.

On a future opportunity, we trust we shall have it in our power to lay the whole regulations before our Readers. In the meantime, our limits will only permit us to state the amendments on them which were proposed.

Of these, the first one which attracted most attention, was a proposal to allow the Lecturer on Mechanics and Chemistry, who, by the present regulations, can communicate only with the Committee, to have a voice in the public meetings. On this amendment, a very protracted discussion took place. Those who were against the Lecturer having any share in the public meetings of the Institution, represented the great influence which he, from his situation, would possess over the members, and which he might employ improperly; and they stated, that he could not engage in their discussions without offending some party, whose respect he would of course lose; and that, his province being the tuition of science alone, he could only be distracted by discussions regarding the affairs of the Institution.

On the other hand, it was answered, that the influence of the Lecturer could not be supposed to extend beyond the province of his lectures; and it was stated, that he naturally was the person most interested in the prosperity of the Institution, and, therefore, should be admitted; that he might be accused at public meetings, and therefore ought to be present, and have it in his power to defend himself, and that, if not admitted to public meetings, he was likely to become the creature and slave of the Committee.

The debate, of which we have thus, as impartially as we could, given the substance, occupied a long time, and was conducted with considerable warmth. For the purpose of coming to a decision upon the question, coolly and maturely, it was agreed, that the votes on it should be taken in writing from the members, on a future night of meeting.—During the agitation of this question, Mr. Steele, Lecturer on Mechanics and Chemistry for the Institution, made two attempts to gain a hearing, but unsuccessfully.

It was proposed also, and agreed, that a requisition from twenty members to the Committee, upon any subject connected with the affairs of the Institution, should make it imperative in the Committee to bring that subject before the first meeting ordinary of the Institution. It had been previously provided, that a similar requisition, signed by fifty members, obliged the Committee to call a meeting extraordinary of the Institution.

It was enacted, that the lecturers for the other Classes should be *elected* by the Mechanics' Class, but that they should be *continued* by their own respective Classes.

By the regulations which were read, all books on the subject of Religious or Political controversy were excluded. As an amendment to this, it was proposed, that such books should be admissible. In favour of this amendment, it was stated, that many eminent scientific writers, were also writers on subjects of religious and political controversy; and therefore, by this regulation, every complete collection of such writers' works were excluded. The works of Bishop Watson and of Dr. Priestley, were mentioned as examples. And the regulation was represented as betokening illiberality of spirit. In favour of exclusion, it was answered, that the scientific works of the authors in question, were easily procurable, separate; and it was stated, that the object of the Institution, which was the acquisition of science, was foreign to religious and political controversy. And the possibility was mentioned, that such works as those of

Paine might obtain admission.—The meeting decided in favour of the admissibility of works on subjects of religious and political controversy.

A great many regulations were read and approved; but as the discussions had protracted the meeting to a late hour, and as farther discussion was anticipated, the meeting adjourned till Tuesday night, at eight o'clock, when members are to bring their written votes on the question, whether the Lecturer should be allowed to have any share in the public meetings of the Society. It was first proposed, that the adjournment should be made till Wednesday. "I second that motion," says a member, "and," continues he, "I move that we adjourn till Thursday!" A hearty laugh greeted his bull.

Our Readers and Correspondents will excuse us this week, for deferring the Philosophical Articles and Correspondence, &c. to make room for this Report.

MISCELLANIES.

Arctic Expeditions.—It is stated in the newspapers, that a combined Expedition to pursue the discoveries towards the North, will be sent out at the end of Spring. The plan mentioned, is, that Captain Parry in the Hecla, and Captain Hoppner in the Fury, shall proceed to explore Regent's Inlet; while the Griper, Captain Lyon, proceeds to Repulse Bay, and remains there till the coast is surveyed to the Cape Turnagain of Franklin. The enterprising officer whose name is thus commemorated, also renews his toils, and is appointed to go to Fort Enterprise (his old station) and thence to survey the coast, if possible, to Icy Cape. This is a fine scale of operations: Heaven grant it may be successful!

Extinction of Fires in Chimnies.—M. Cadet Vaux, reflecting on the circumstances of a fire, when it occurs in a chimney, was led to endeavour at its extinction, by rendering the air which passes up the flue unable to support combustion. This object he obtained by the simple means of throwing flower sulphur on the fire in the grate, and so effectual was it, that a faggot suspended in the chimney, very near the top, and, consequently, near the external air, when set on fire, and burning with fury, was instantly extinguished on the application of the sulphur below. This process is the more applicable, inasmuch as it does not require that all the oxygen in the air should be converted into sulphurous acid gas, before it passes up the chimney; on the contrary, a comparatively small proportion of the latter gas, mixed with common air, is sufficient to prevent its supporting the combustion of common combustible bodies.

NOTICES TO CORRESPONDENTS.

We have received several communications (particularly from Greenock) without signatures, which, of course, cannot be inserted. We request our Correspondents to attend particularly to J. D.'s hints in our last.

H. N., O. H., L. W., and 'A Spinner,' are superseded.—J. T. and 'An Old Sailor' cannot be inserted.—We would thank A. to be more explicit in his communications.—We differ in opinion from J. P., and though desirous of pleasing him, we question the propriety of inserting his last communication; and, likewise, that of 'A Highlander.'—T. and R. H. will be inserted.—A. Z.'s question is, perhaps, too common.—D. B. under consideration.—J. D., Tradeston, is unintelligible.—S. S. will be attended to.—We thank J. G. S. for his *broad* hints.—M. M. R. is informed by G. M. that 1800 was not a leap year.—'Proportion' need not send us any more questions from Halbert's Arithmetic, as we have the book.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement which is the subject of their notice.

Published every Saturday, by W. R. M'PHUN, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed.

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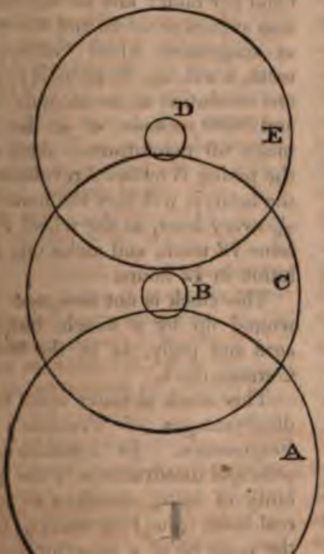
J. CURLL, PRINTER.

THE GLASGOW
MECHANICS' MAGAZINE.

> " Time in advance, behind him hides his wings,
> And seems to creep, decrepit with his age:
> Behold him, when past by; what then is seen,
> But his broad pinions swifter than the winds?"—*Young.*

No. IX. *Saturday, 28th February*, 1824. Price 3*d.*

IMPROVEMENTS IN CLOCK-WORK.



IMPROVEMENTS IN CLOCK-WORK.

Description of a Clock that shows the hours, minutes, and seconds, having only four wheels and two pinions in the whole movement.

The dial of this clock is the same as that of a common eight-day clock. The wheel work is shown in fig. 1 and 2. The great wheel A (fig. 1) contains 60 teeth, is $2\frac{1}{2}$ inches in diameter, and makes one revolution in an hour; the axis of this wheel carries round the minute hand, which may be set to any time without affecting the motion of the clock, by being put tight on the round end of the axis. This wheel turns the pinion B, of 10 leaves, which carries on its arbor the wheel C, of 60 teeth, and $2\frac{1}{8}$ inches in diameter. The wheel C, turns the pinion D, of 6 leaves, which carries on its arbor the crown or scapement wheel E, of 30 teeth, and the seconds' hand. The wheel E, moves a pendulum that vibrates seconds, as in the common eight-day clock.

On the axis of the great wheel A, and on the outside of the side-plate, is put a brass pipe which must be fitted loose on the axis, so as to be turned easily backward and forward without affecting the motion of the axis; on one end of this pipe is fixed the hour hand, and on the other, the wheel F, of 72 teeth, and $2\frac{1}{2}$ inches in diameter; the teeth of this wheel are cut the same as those of the crown or scapement wheel. On the arbor of the pinion B, and on the outside of the side-plate, is fixed a catch (a kind of pinion of one leaf) that takes into the teeth of the wheel F, and turns it onward, one tooth for every revolution of the pinion B. To prevent the wheel F from turning round by the weight of the hour hand, a small spiral spring of wire is put on the outside of the brass pipe, and presses on it, from the back of the dial.

As the great wheel A contains 60 teeth, and the pinion B 10 leaves, the pinion B will make 6 revolutions for one of A; and as the wheel C contains 60 teeth, and the pinion D 6 leaves, the pinion D will make 10 revolutions for one of C; now, 6, the number of revolutions of the pinion B, multiplied by 10, the number of revolutions of the pinion D, gives 60, as the number of revolutions of the seconds' hand per hour; and as the pendulum swings seconds, and the crown or scapement wheel contains 30 teeth, it will take 60 seconds to make one revolution of the seconds' hand, and 3600 seconds, or an hour, to make 60 revolutions. And since the pinion B makes 6 revolutions in the hour, it will turn the hour hand $\frac{1}{12}$ every hour, as the wheel F contains 72 teeth, and make one revolution in 12 hours.

This clock is not designed to be wound up by a winch, but by a cord and pully, as in the 30-hour German clock.

This clock obviates some of the disadvantages of Franklin's and Fergusson's. In Franklin's, the principal disadvantage is the possibility of being mistaken as to the real hour. In Fergusson's, unless the work be of a superior quality, and the scapement very nicely adjusted, it will be apt to stop, on account of the load on the crown wheel, and the smallness of the vibrations of the pendulum.

In Number III. we gave some account both of Franklin's and Fergusson's clock, and, consequently, we refer our readers to that account for farther information on the subject. As some of our horological Correspondents have found some fault with the improved clock

in that Number, we have determined to get one constructed on the plan, and we shall by and by favour them with the result of our experiments. In the meantime, we trust the above mode of constructing a clock, will please them better than the last. To excite their curiosity, however, and set their inventive powers a-working, we shall subjoin the following account of some very curious clocks.

Among the modern clocks, those of Strasburg and Lyons, in France, are celebrated for the richness of their furniture, and the variety of their motions and figures. In the former, is exhibited a celestial globe with the motions of the earth and planets, and the increase and decrease of the moon; also, a perpetual almanack, on which the day of the month is pointed out by a statue. A golden cock claps his wings, and announces the hour, which is struck on the bell by an angel, who opens a door and salutes the Virgin; near him stands another angel with an hour glass, which he turns as soon as the clock has finished striking; the first quarter of the hour is struck by a child with an apple, the second by a youth with an arrow, the third by a man with a tip-staff, and the fourth by an old man with a cane. In the latter, besides similar appurtenances to the above, two horsemen encounter and beat the hour upon each other; a door opens, and there appears in the theatre the Virgin with the Holy Child in her arms; the Magi with their retinue, marching in order and presenting their gifts; and two trumpeters sounding all the time to proclaim the procession.

These clocks, however, were far excelled by two that were made, some years ago, by English artists, as a present from the East India Company to the Emperor of China. These two clocks are in the form of chariots, in each of which a lady is placed in a fine attitude, leaning her right hand on a part of the chariot, under which appears a clock of curious workmanship, little larger than a shilling, that strikes, and repeats, and goes, for eight days. On the lady's finger sits a bird finely modelled, and set with diamonds and rubies, with its wings expanded in a flying posture, and which actually flutters for a considerable time, on touching a diamond button below it; the body of the bird, in which are contained part of the wheels that animate it, is less than the 16th part of an inch. The lady holds in her left hand a golden tube, little thicker than a large pin, on the top of which is a small round box, to which is fixed a circular ornament, not larger than a sixpence, set with diamonds, which goes round in three hours in a constant regular motion. Over the lady's head, is a double umbrella, supported by a small fluted pillar, not thicker than a quill; under the cover of which, a bell is fixed at a considerable distance from the clock, with which it seems to have no connection, but from which a communication is secretly conveyed to a hammer that regularly strikes the hour, and repeats the same at pleasure, by touching a diamond button fixed to the clock below. At the feet of the lady is a golden dog; before which, from the point of the chariot, are two birds fixed on spiral springs, having their wings and feathers set with stones of various colours, and they appear as if flying away with the chariot, which, from another secret motion, is contrived to run in any direction, either straight or circular, while a boy, that lays hold of the chariot behind, appears to push it forward. Above the umbrella are flowers and orna-

ments of precious stones; and it terminates with a flying dragon set in the same manner. The whole is of gold, most curiously executed, and embellished with rubies and pearls.

NEW MODELS FOR PRINTING CLOTH.

To the Editor of the Glasgow Mechanics' Magazine.

SIR,—If the following drawings and short description of two new models for printing, lately invented by me, be deemed worthy of insertion in your Magazine, they are at your service.

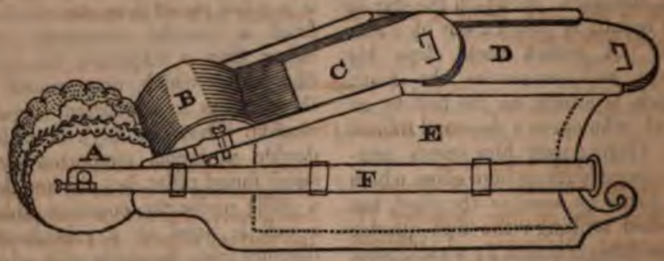
I am, SIR,

Your most obedient Servant,

N. DISMORR.

Barrowfield Dye-Works, Jan. 5th, 1824.

No. I.—PACKET SURFACE.



The model, No. I., or Packet Surface, is chiefly intended for calico-printing; and being the first ever made, it is of course capable of great improvement. It should be cast in brass. Its particular use was to print borders in circles, waves, &c., with any thickened colour, which cannot be done with the straight blocks. It also saves the expense of boy's wages, tubs, sieves, &c., and is capable of being put into general use.

The pressure given on the cloth, by drawing the model towards you, puts every thing in motion.

A, is the pattern, cut on a roller of wood.

B, is the sieve, being a sieve-cloth sewed on a wooden roller.

C, is the brush, which slides in a groove.

D, is the lid, which slides in a groove, after the colour is poured into E, and serves to keep in the colour.

E, is the machine itself, containing the colour inside, and should be cast in brass.

F, is a brass slide, to bring the roller A close to the sieve B, whether it be large or small.

The inside of the machine is made hollow up to that line where the sieve and brush comes in contact. The dotted line shows the hollow part.

No. II.—HAND SURFACE.

The model No. II., or Hand Surface, is chiefly intended for printing robes, circles, waves, &c., in tambour manufactures.

A, is the print, cut on a wooden roller.

B, is the sieve, being a piece of flannel rolled round.

C, contains the colour, to feed the sieve.

D, the body of the machine, which should be cast in brass.

By drawing this machine also towards you on the cloth, the slight pressure puts all in motion.

ON BLASTING ROCKS.

To the Editor of the
Glasgow Mechanics' Magazine.

Sir,—In reading Number IV. of your Magazine, I observe, amongst the List of Premiums offered by the Society of Arts, one for an improved method of boring or blasting rocks in mines, &c.

I have taken the liberty to hand you an improved method of blasting rocks with gunpowder, on true philosophical principles, by which, not only 4-9ths of the gunpowder is saved, (which in itself is very considerable, where the consumption is great, particularly during war), but which far exceeds any method I have ever seen in its execution and effects. It has been practised for near a century, in the extensive iron mines in Sweden; and only requires to be generally known in this country, to be properly valued.

Suppose a hole, in *the usual method* of blasting, requires nine inches of gunpowder; instead of filling it completely, leave four inches next the bottom empty, and above this space put five inches of gunpowder, which is supported by a piece of pasteboard cut to the size of the hole, with a stick underneath, and attached to it in the middle. To prevent the stick head, or pasteboard, from being air-tight, four notches may be made, of such a size, as to allow the air, but not the gunpowder, to pass through. Then stem it, and fire it, in the usual way. The principle on which it acts, is the rarefaction of the four inches of air in the bottom of the hole, when heated by the explosion of the gunpowder, and its *consequent expansive power, or force.*

I cannot, perhaps, give a clearer demonstration of this force, than by supposing a fowling-piece to be

loaded, and the charge not rammed home, as it is called; *i. e.* if the least air remain in the bottom of the barrel, the consequence, every one knows, would be the bursting of the barrel. The intention, of course, in this case, is to burst the barrel. If, Mr. Editor, you deem this of sufficient merit to occupy a corner of your valuable Magazine, I should feel obliged by its insertion, and may probably furnish you with occasional hints on practical mining.

I am, SIR,

Your obedt. Servant.

JOHN HENDERSON.

Elgin Colliery, near Dunfermline, 18th February, 1824.

ON SOLDERS.

To the Editor of the GLASGOW MECHANICS' MAGAZINE.

SIR,—In the wide range of subjects treated of in your useful Magazine, I beg leave to call your attention to the article *solders*; which, you must be aware, is of great importance to a numerous class of workmen in metals. I have examined the Encyclopædia Britannica and other books, on the subject, in quest of a silver solder that runs easy, and is very near the same colour as silver, but could never find it. Such a solder is used in the manufacture of tin-plate ware, at Sheffield, &c. but would be useful for many other purposes, were it generally known, especially to silver-smiths. Having made several experiments to find a solder of this description, I send you the following, as it runs easy, and may be useful, when used near another soldered place, but it is not so near the colour of silver as that I have alluded to; *viz.*—1 oz. of pure silver, 1 oz. of spiler solder, and nearly 2 dwt. of grain tin, to be melted in the order laid down; care must be taken in the rolling; and it should be often annealed, as it is brittle. If any of your correspondents knows the component parts of the solder alluded to, and would have the goodness to communicate it, I am sure it would oblige many, and very much oblige,

SIR,

Your very humble servant,

A LEARNER.

Edinburgh, Feb. 12, 1824.

We should like to know the celebrated writer mentioned in the postscript to the above letter, from 'A Learner,' and in what part of his works the statement contained in it is to be found, before we insert his query founded upon that statement.

ON FILTRATION.

To the Editor of the GLASGOW MECHANICS' MAGAZINE.

SIR,—Filtration is of such importance to many public works, particularly in printfields and dye-works, that it has long been the study of many persons connected with such works. Among the varied and numerous trials which have taken place of late, none has been found to excel, or equal the filter made with the refuse of the furnaces, or what we call *danders*, as it perfectly excludes all impurities contained in the water, except iron ore. It has been tried in two places in

the neighbourhood of Glasgow, with great success, and only requires to be publicly known to make it generally adopted. It is far superior to the filter obtained either from sand, or gravel, which have long been the usual substance employed. These *danders*, also, admit of a road being made over the water; without impeding its progress, being sufficiently porous. The process is best accomplished by building two small dykes, of rough stones, at any distance from each other, according to the width wanted, and filling up the spaces with *danders;* and as most public works can furnish the materials themselves, it is attended with no expense.

D. R.

INVENTIONS AND DISCOVERIES OF ARCHIMEDES.

HAVING given, in our last, a brief sketch of the life of Archimedes, we now proceed to mention some of those achievements in art and science, which have caused his name to survive the wreck of 2000 years, and which will prevent it from sinking into oblivion, so long as philosophy has any charms for the human mind, and the affairs of life require to be transacted by the accuracy of measurement and calculation.

When we contemplate the state of the arts and sciences, at the time that Archimedes appeared in the world; and when we consider the number and variety of his inventions and discoveries, we must be struck, alike with astonishment and admiration, at his genius. The greatness and splendour of the performances of Archimedes, have procured him the appellation of the Newton of antiquity, as a similar comparison of the genius of the latter philosopher with that of the former, procured Newton the title of the Archimedes of modern times. The names of both, mark most important eras in the history of science, with this difference, that the one is incorporated with its infancy, the other with its maturity. Invention has always been considered as a greater characteristic of genius than improvement, and independent of all comparisons, if we estimate the intellectual powers of Archimedes by this criterion, we must assign him a place in the very highest rank of philosophers.

As a mechanician, the fame of Archimedes is indeed unrivalled. There, probably, never was a time nor a place in which mankind were totally devoid of all knowledge of mechanics as an art; but history carries us back to a period, when, as a science, they were entirely unknown. Prior to the time of Archimedes, the notions that existed respecting the laws of mechanical bodies, did not deserve the name of science. The opinions of Aristotle on this subject, though entitled to consideration, sunk before the splendid genius of the Syracusan philosopher; and though the former had made some slight advance in this branch of knowledge, it has always been regarded so small, that the latter has ever been considered as the real founder of the science. The inclined plane, the pulley, and the screw, have generally been considered as the trophies of his genius, though no philosophical account of their principles was given to the world, till about five hundred years after he flourished. He was the first that investigated the powers and properties of the lever, by making geometry subservient to the illustration of this branch of mechanics. During his inquiries on this subject, he

discovered, that there is, in every body, or in every system of bodies, a particular point, in which all the force or pressure is concentrated, and that if this be duly supported, the whole mass will be held in equilibrium. This he distinguished by the name which it still bears, of *the centre of gravity*. This gave birth to his Treatise concerning equiponderants, a work which is still extant. He is not less famed for his practical, than for his scientific skill in mechanics. The ancients ascribe to him the honour of about forty different mechanical inventions; and the well-attested fact, that he suspended the fall of his native city, for three years, against the attacks of a powerful Roman army, under the command of such a general as Marcellus, speaks wonders in praise of his genius.

Hydrostatics is another branch of natural philosophy, for whose origin the world is indebted to Archimedes. He pointed out the difference between fluids and solids, and what it was that constituted the equilibrium of the former. His investigations on this subject gave rise to his Treatise on floating bodies, and are allowed to have laid the foundation of naval architecture. It is probable that his attention was first directed to this subject by a problem which was submitted to him by his royal kinsman. Hiero had given a workman a certain quantity of pure gold to make a crown. The crown being finished and brought to the king, though not deficient in weight, was suspected by him to be adulterated with some baser metal. To discover this adulteration was a difficulty, for the solution of which, the powers of science, at that time, were wholly inadequate; but it proved a fit opportunity for the display of the genius of Archimedes, and the transmission of its benefits to posterity. Having considered this question for some time, without arriving at a solution, the philosopher happened to go into the bath one day, probably with his mind full of the subject; and observing that, as he sunk in the water, a quantity of the fluid was displaced, exactly proportioned to the bulk of his body; the thought immediately flashed upon his mind, that any other body of equal bulk, whatever might be its weight, would produce the same effect. Here, then, was a criterion for trying the purity of Hiero's crown. Gold being the heaviest of all metals, then known, he inferred, that in proportion to its weight, it must, when immersed in water, displace a less quantity of the fluid than any other metal. Elated with this discovery, to an uncommon degree of extacy, according to report, he sprung from the bath, and ran home, through the city, like one frantic, exclaiming, "I have found it, I have found it." After a series of experiments, he not only ascertained that the king had been defrauded, but to what amount.

It is presumable, from the notice of several ancient writers, that Archimedes was well acquainted with the science of astronomy. Indeed, to this study he is said to have been particularly addicted; and fame gives him the credit of having constructed a glass globe, in which were represented the circles of the sphere, and the motions of the planets. To this machine there are several allusions in the poets of antiquity; but none gives so circumstantial a description of it as Claudian. The following is a translation of his epigram upon this singular piece of mechanism;—

When, in a glass's narrow sphere confined,
Jove saw the fabric of the Almighty mind,
He smiled, and said, "Can mortals' art alone
Our heavenly labours mimic with their own?
The Syracusan's brittle work contains
The eternal law, that through all nature reigns.
Framed by his art, see stars unnumbered burn,
And, in their courses, rolling orbs return:

His sun, through various signs, describes the year,
And, every month, his mimic moons appear.
Our rival's laws his little planets bind,
And rule their motions by a human mind.
Salmoneus could our thunder imitate.
But Archimedes can a world create."

Archimedes appears, also, to have had considerable skill in the science of optics. By a particular combination of mirrors, he is reported by historians to have burned either the whole, or part of the Roman fleet, during the siege of Syracuse. This achievement has been questioned by many modern philosophers, but whether it was actually performed, or not, its practicability, at least, has been fully demonstrated by Buffon; and unless he had accomplished some such feat as this, it can scarcely be conceived how the report of it could have been so generally credited, particularly at a time when the world were strangers to the wonders of burning instruments.

Although the discoveries of Archimedes in mechanics were both splendid and triumphant, yet, even they were eclipsed by those he made in the regions of pure science. And while Euclid had laid the foundation of geometry in his immaculate Elements, Archimedes raised the noble superstructure to a very high elevation, by the discovery of a series of propositions that constitute the most brilliant acquisitions of the ancients. In his Treatise on the properties of the cylinder and the sphere, he demonstrated this most beautiful theorem: *That the superficial area, as well as the solid content of every sphere, is equal to two-thirds of that of its circumscribed cylinder.* So justly enamoured was he of this admirable property of these solids, that he requested, after his death, that the figure of the cylinder, with its inscribed sphere, might be engraven on his tomb. And Cicero, during his quæstorship in Sicily, with that noble feeling of regard which true genius always inspires, and teaches to be due to merit, though of a different kind, ordered the tombstone of the philosopher to be sought out, and cleared from the rubbish that concealed it from the eyes of the world.

Archimedes was the first who approximated to the rectification and quadrature of the circle, a problem which has exercised the ingenuity of mathematicians in all ages, and one which seems destined, from the nature of the inquiry, never to be perfectly accomplished. In his book on the *Measure of the Circle*, he demonstrates the following theorem, which is of the greatest practical utility: *That the area of a circle is equal to that of a triangle whose base is equal to the circumference, and perpendicular equal to the radius.* He also proved, *That if the diameter of a circle be reckoned unity, the circumference will be between* $3\frac{10}{70}$ *and* $3\frac{10}{71}$. The method by which Archimedes arrived at this conclusion, is one of the finest specimens of human ingenuity, and is capable of carrying the approximation to the exact circumference, to any degree of accuracy required. This method, indeed, which is denominated the *Method of Exhaustions*, contains in it the germ of all the modern discoveries, and was capable of being applied to the investigation of problems, for which even the genius of Newton found it necessary to invent a new Calculus.

In his work on *Conoids and Spheroids*, he has unfolded many profound and ingenious properties of these solids, and their relations to cylinders and cones of the same altitude. He was the first that ever found the complete quadrature of a curve, by demonstrating, *That the area of the parabola, bounded by a chord, is two-thirds of the circumscribing parallelogram.* The

properties of the solids formed by the revolutions of the conic sections, which he discovered, are equally striking and beautiful, and such as entitle him, when we consider his other discoveries, to the appellation of the *Father of Mensuration*.

In his *Arenarius*, or Treatise on the Number of the Sands, he attempted to show the possibility of expressing by numbers the grains of sand that would fill the whole space of the universe. In this work, he pointed out a property of a geometrical progression that was afterwards made the foundation of the theory of logarithms; so near was this great man to one of the finest inventions of modern times. Had the mode of notation employed by the Greeks, though vastly superior to that of any other ancient nation, been less cumbrous than it was, there can be no doubt but Archimedes would have anticipated many discoveries of the moderns. Indeed, it is wonderful that he did not attempt to simplify that notation; but the tide of his ideas had already flowed beyond it, and, in the long series of ages that succeeded, no genius less lofty was found, to supply the deficiency, till the torch of science again illumed the world. In fine, the writings of Archimedes constitute some of the most precious relics of antiquity, and show that, though the progress of discovery is in general slow, there are some who can pass the point where men of ordinary capacities are at a stand, and, by the vigour of their minds, anticipate the labour of ages.

C. R.

ON THE PROCESS FOR DISCHARGING TURKEY-RED.

To the Editor of the
GLASGOW MECHANICS' MAGAZINE.

MR. EDITOR,

WHEREVER the merit of an invention or discovery is laid claim to by one who, conscious that he has no right to such distinction, uses such means to gain the applause, and perhaps remuneration, due to another, it becomes the duty of every honest man, who knows the facts, to come forward and lay them before the public.

I was not a little astonished in reading a paper, in No. VIII. of your Magazine, entitled, "*On the Process for Discharging Turkey-Red*," to meet with the following lines:—"This merit (*viz.* the merit of discovering the discharging process by means of presses,) belongs to Mr. John Miller, now in the employment of Messrs. Charles Macintosh & Co. He completed his invention in the year 1802." This is going far enough, if your informant is ignorant of the real fact; and perhaps too far, if he knows it. But I will endeavour to satisfy you as to who were the real discoverers, (for more than one lays claim to it,) and at a much later date than Mr. Miller.

If your informant will have the goodness to turn with me to the article "*Bandana*," in the ENCYCLOPÆDIA EDINENSIS, he will find the following paragraph:—"About the year 1794, after the oxygenated muriatic acid had been successfully applied to the art of bleaching, its property of destroying vegetable colours became pretty generally known, and gave rise to a new branch of the cotton manufacture, which was then known by the name of *clouding*. The processes by which this branch was conducted were first by compressing the several portions of the dyed yarn which were to retain the colour between two slips of wood, by means of screws, or some other expedient, and afterwards immersing the whole in the oxymuriatic acid. Those parts, therefore, which were exposed to the action of the liquor, were discharged, leaving the colours unimpaired which were secured between the slips of wood."

Again: "From an intimate acquaintance with these processes, the idea of applying the screw-press to the discharg-

ing of Turkey-red handkerchiefs, now called *Bandanas*, was naturally suggested; and accordingly, during the years 1800 and 1801, Mr. Robert Tweedie, Turkey-red dyer to Mr. Monteith at Blantyre cotton-works, made several experiments of this kind, by means of two plates of copper, with a number of holes drilled through them, corresponding to the pattern, by which the discharging liquor was transmitted through the cloth. These experiments were made on single handkerchiefs, folded into one-eighth part of their size, and strongly pressed between the plates with screws. After applying the liquor to the perforations in the plates, he found that the spaces opposite to the holes were discharged, while those that were secured by the pressure of the plates were completely preserved." Now, Mr. Tweedie and Mr. Colin M'Callum, also in the employ of Mr. Monteith at that time, had a dispute between themselves, as to who was the original discoverer of the process; but, as both these men are now dead, we will allow their disputes to die with them. It is sufficient for us to know, that the date of their discovery is prior to that of Mr. Miller's.

Another thing I would beg leave to mention to your informant is, that Mr. George Rodger, who is at present manager of Messrs. H. Monteith & Co.'s works at Barrowfield, so early as the year 1802, discharged and sold the first cotton Bandana handkerchiefs* produced in this country.

There are a number of other circumstances that I could mention, but I trust your readers will be already satisfied.† H.

To these statements, we have to answer, that we were quite aware that some attempts towards a process similar to Mr. Miller's had been made by persons in the employment of Messrs. Monteith, Bogle, & Co., though till now we were not aware at what time, nor by what persons they were made. These particulars are now supplied, we presume with tolerable accuracy, as the above statement, taken from the Encyclopædia Edinensis, is, we understand, from the pen of Mr. Monteith. But we were also aware that the attempts which were made (however laudable) never succeeded in accomplishing a tolerable manufacturing process, or in producing a marketable manufacture. Mr. Monteith, himself, it will be seen, calls these attempts *experiments*. In farther proof of this, it will be sufficient to mention that, upon seeing the discharged work performed by Messrs. M'Brayne, Stenhouse, & Co., Messrs. Monteith, Bogle, & Co. abandoned all their attempts in this style of work, and got their discharging performed by those gentlemen for a considerable time. We have the authority of Mr. George M'Farlane, then managing-partner of the house of Messrs. M'Brayne, Stenhouse, & Co., for stating that they received their instructions for discharging solely from Mr. Miller, and that Mr. M'Farlane invited Mr. George Rodger, then in the employment of Messrs. Monteith & Co., and Mr. James Gray, likewise then in their employment, to see Mr. Miller's apparatus; and they saw and examined it accordingly. It was shortly after this, that Messrs. Monteith & Co. commenced the process which had thus been handed down to them from Mr. Miller, and which, in their hands, has been in some degree improved.

It is not asserted by our Correspondent, and indeed we find, on inquiry, it is not pretended by those most interested against the claims of Mr. Miller, that he was in the smallest degree acquainted with the attempts made by persons in the employment of Messrs. Monteith & Co. Whatever merit therefore may be claimed by these persons for their attempts, or for the partial success of these attempts, the process for discharging Turkey-red, the fruit of his own ingenuity, and ripe for practical application, was the invention of Mr. John Miller and of him alone.

So much we have been able to state in the absence of Mr. Miller; who, be it observed, is 400 miles distant. However far therefore these statements may be supposed to substantiate his claims, they must be feeble compared with those proofs which his presence might have afforded us.

Under the impression that some light might be thrown on the early history of this invention, by an examinaion of Mr. Miller's private papers, thetwriter

* Mr. Rodger still preserves the plates with which they were done. The greater part of them consist of mahogany. H.

† We have omitted in our Correspondent's letter, some remarks on Mr. Miller's new invention; because, as his process is not divulged, these could only lead to useless controversy. On inquiry at our Publisher's, it may be ascertained when and where the specimens may be seen.

of this article caused such an examination to be made by his family. In their search, the following copy of a letter from Mr. Miller to a correspondent was found, which we insert, as it affords some light on the subject.

Dalmuir Alkali Works, 5th Jan. 1818.

To —— ——, Esq.*

Dear Sir,—From the conversation you and I have had respecting printing, or rather, discharging of Turkey-red, I take the liberty of handing you the following statement of facts, respecting the invention of it.

Near the latter end of the year 1802, Mr. Robert Tweedie (now deceased) inquired several times at me if I thought I could print upon, or discharge Turkey-red, so as it might become a trade. Not long after this, I turned my attention to that object, and by the middle of November had the model of a discharging-press at work; the patterns produced from which I shewed Mr. Tweedie, in the course of this same month, which he said went far beyond his expectations, and were completely what he could wish.

After being repeatedly solicited by Mr. Tweedie for a sight of the press-model, I took it over to him, and, at his earnest request, allowed it to remain with him that night, and before I took it away, he had Mr. Andrew Bogle, from Glasgow, to inspect it; who, so soon as he saw it, sent immediately off to Blantyre Works, for three of the mechanics employed there, for them to come and see it likewise, so as they might make one upon the same plan. All this, however, was unknown to me, at that time. It, however, happened that I had the model taken away before these men from Blantyre arrived; but as soon as they reached Mr. Tweedie's, I had the following note:—

"Sir,—Be so good as send, per bearer, the model that was over here, as there is a particular person here wishes to see it.

(Signed) Robt. Tweedie.

[Shawfieldbank,] 29th Dec. 1803."

To Mr. John Miller, Printer.

This request was not complied with, as I knew his intention by this time.

After showing Messrs. Monteith and Bogle six or eight patterns, produced from my small discharging-press, I had, at their request, several interviews, when they were always anxious to learn how the press was constructed, and, indeed, every particular respecting the invention, but, from the manner in which the inquiries were made, I declined giving any satisfaction.

* * * *

* * * *

I am, Dear Sir,

Your most obedient servant.

John Miller.

The letter from Mr. Tweedie, to which Mr. Miller refers, was, also, found among his papers; and, in confirmation of his statement, we have received the following:—

To the Editor of the
Glasgow Mechanics' Magazine.

Sir,—I can confirm the statement in the preceding letter, in so far as concerns Mr. Miller's being warned of strangers, as I was the person who gave Mr. Miller notice they were coming.

James Barr.

No. 12, Dale-Street, 25th Feb. 1824.

* The address of this letter may be had at our Publisher's, for the satisfaction of such as may wish to ascertain its genuineness.

DASH-WHEEL QUERY.

Sir,—It is certainly a *desideratum* in practical mechanics, to devise a method by which the *inertia* of a heavy machine, when *thrown into gear*, may be overcome so gradually as not to give any perceptible *shock* to the moving power. There is, perhaps, no machine, in the working of which, this defect is more obvious than that of the dash-wheel. *And here I beg leave to observe, that notwithstanding* the attempt on the part of your Correspondent 'M,' in No. IV., under the head of 'Loch Ness,' to quiz 'An Inquirer after Knowledge,' in No. III., I am not to be deterred from using, nor to be considered under any obligation to "explain," terms that are familiar to all those who are *interested* in the discussion.

The *metallic strap*, when on a *turned* collar, not less than twelve inches diameter, is perhaps the best,

for it is now, I believe, in general repute. I deem it necessary, that the groove for the reception of the strap be turned, and that the *blacksmith* have it by him when he *forges* the *strap*.

I am not aware, that advantage has ever been taken (to apply it to this purpose) of the principle on which the great gearing of the block-machinery, in Portsmouth Dock-Yard, (invented by Mr. Brunel, and so ably executed by Mr. Maudsley of London,) has been constructed. The wheels are not made *dead-fast* on the shafts, but have *bored-out* conical *eyes*, which are ground on to turned conical collars on the shafts, and fixed sufficiently thereon by a few blows of a hammer. Should any part of the machinery meet with more resistance than it is calculated to overcome, the shaft turns round in the wheel, the wheel immediately slackens, by slipping towards the smaller end of the collar; and thus is the shaft left at liberty to go freely on, while all the gearing to which this wheel *gave* motion remains at rest.

Could not this principle be acted on, in the *engaging* of dash-wheels? Suppose a pair of dash-wheels be wanted to work alongside of one another, and to receive their motion from a shaft parallel to their axes, and betwixt them. Let a spur wheel, *fixed* on the axis of this shaft, work into spur wheels * with conical *eyes*, fitted on to conical collars, wedged on the projecting square ends of the gudgeons of the dash-wheels; and let these wheels (spur wheels) have bayonets cast on them, that *levers* may be applied to move them longitudinally, for the purpose of engaging and disengaging the dash-wheels, which will never need to be so much as to disengage the spur wheels. Now, if these wheels are brought up *gently* on their collars, the friction will not be so great as at *once* to *start* the dash-wheels at *full speed*, but will overcome their *inertia* gradually, and by a subsequent jerk of the lever, they may be *hardened up* so as to continue the motion of the dash-wheels at a proper velocity. I will expect to learn, through the medium of your miscellany, if this method has been, or may be, tried, and with what success.

I am, SIR,

Your obedient servant,

W. G.

Banks of the Leven, 14th Feb. 1824.

* If the wheels are wanted to work both the same way, then an intermediate wheel may be applied.

STRAIGHT EDGE QUERY.

To the Editor of the GLASGOW MECHANICS' MAGAZINE.

SIR,—As none of your Correspondents seem to have offered a solution of the third question by 'An Observer,' in the 30th page of your work, I here send you my opinion on the subject.

In the first place, I think the statement of your querist is mathematically *false; because,* a line *drawn from any height* on land to the surface of the sea, must deviate from the level. Indeed, several rules in the practice of levelling are founded on this very principle.

In the second place, I think, that though mathematically false, yet, as the error in cases of small elevation is trifling, the eye may be unable to detect it. Calculation shows, that, at the height of six feet above the surface of the sea, the deviation will not exceed $2\frac{1}{2}$ minutes. On

the top of Ben Nevis, it will not amount to a degree.* Nay, should even Campbell's "giant of the western star" make the experiment on "his throne of clouds," his straight edge will only require to be inclined about 2½ degrees, to make it point exactly to the surface of the sea. Refraction is not taken here into account, as the calculations were not made so minutely as to render it necessary.

S.

Paisley, Feb. 11, 1824.

* Only 49 minutes.

LETTERS AND QUERIES.

PLAN to render STEAM BOATS more accessible from shore.

SIR,—Anecdote, perhaps, does not come within the range of your plan; if it does, allow, if you please, the following a place in your useful Magazine.

A friend of mine and his wife, together with a few neighbours, to pass a holiday in last autumn, projected a sail to Largs, in one of the steam vessels. The morning was so pleasant and calm, that all the females were got aboard at Renfrew, without any other assistance than a hold of their husbands' arms with the one hand, and a firm grasp of the edge of the ferry boat with the other. They were soon lodged safe in the vessel. The beautiful scenery on the banks of the Clyde induced some of the women to come on deck to view it, but to my friend's wife, the cabin of the vessel was only a cell in her prison. Eden itself could not have excited in her curiosity enough to have brought her on deck. The projected pleasure of the sail was to her only so much torture. The announcing of landing was the pleasantest voice she had heard on the voyage.

The day, however, by the time that they arrived at Largs, had become breezy, and, on coming up to disembark, the dash of the wave, and the ride of the vessel completely stupified her with giddiness; to step into the yaul, buffeting on the passing wave, was, to her imagination, instant death; she could not think of it. The captain soothed and advised—my friend raged—the men laughed—whilst she screamed—but all their joint powers could not, without violence, get her ashore; the result was, the company went ashore, to enjoy themselves, and she returned to her prison. On returning with the vessel to Greenock, *the landing was not* without its terrors—*the tide was ebb,* and to ascend the shaking plank had its sufficiency of horrors.

The question will readily occur to every one who has witnessed a steam-vessel disembarking her passengers at low water on the breasts of Port-Glasgow or of Greenock, cannot something be done to enable our female friends to get easier landing? Every thing has been done which artists can devise, to render the accommodation within them agreeable; and I am persuaded, that it only requires a hint, to have something added to them, to obviate this inconvenience, especially as I observe, by a paragraph in the *Glasgow Chronicle*, that several of the vessels are at present fitting up for their summer voyages.

The rise and fall of the tide are so little at Glasgow, that something similar to what is used on the Great Canal might do there; but such would be useless at Port-Glasgow and Greenock, or other places, where the breast is necessarily so far above the deck of the vessel at low water. What I would wish to see done is something that would accommodate itself to all places, and could be carried along with the vessel to be ready at all times. Till something is brought forward by our brighter geniuses, allow me to suggest the following:

Let a flight of steps, or, as it is provincially called, a trap-ladder, be hinged to the outer edge of the top of the box that holds the water-wheel; twice the breadth of the said box will in general be sufficient for the length of the ladder. Let a joint be made in the middle of it, that, when it is not in use, it may be doubled up, and lie folded on the top of the box; the hinge of this joint will require to be on the under edge of the two sides, or, as they are called by Carpenters, spring-boards; that, when they are extended in one length, the ends of

the boards may press against each other, and, being held by the hinge, form, as it were, one stair. This hinge will give it another advantage besides convenient stowing, as it will allow one half of it to be used, and the other to hang down, when the breast is of a moderate height.

Say the steps are made seven or eight inches in breadth, the inner edge of them moving on centres in holes in the spring-boards, made near the bottom of them, the outer edge of them moving also on centres, in holes made in a piece of wood that slides on the inner sides of the spring-boards. These slides may be fixed to the spring-boards by a bolt and nut, for which, a series of holes must be made in the spring-boards to suit the various elevations. When the angle is great, the front of the steps, and consequently the slides, will be near the upper edge of the sides, as it decreases, they will move in, till (when the vessel is on a level with the breast) they form a flat on which the passengers may walk ashore.

On the end of each of the steps, let an upright be raised, fastened to them by a hinge, and a hand-rail put on the top of them, of which the timorous may take hold. As the steps will thus be always horizontal, the supports of the rail, rising from them at right angles, will stand perpendicular.

Let the breadth of the passage be three feet, and the rail the same in height, it will then, when not in use, fall down within the spring-boards, and not increase the bulk of the whole when folded up. A catch and eye will be required on the outside, to prevent the rail, when in use, from falling in; the ends of the uprights resting on the steps, outside of the hinges, will be sufficient to keep it from falling out. A rail on the one side will be enough. A very little time will set the steps to the elevation suitable to the first breast at which the vessel may touch; the knowledge which the men possess of the tide and place will enable them to do it, in some of the idle minutes which they have on the voyage.

By having this, or some such contrivance, attached to the vessel, the most timorous female will be able to walk ashore with her child in her arms, and escape not only the fears for her own safety, into which she is thrown by the present method, but also the doubly-harassing fears she must feel when looking back from the breast, and beholding her offspring in the arms of one whom she imagines a ruthless and unfeeling seaman, about to enter on the perils from which she has so narrowly escaped.

Your's respectfully,

Paisley, 25th Feb. 1824. A. B.

QUERIES, &c.

1. What is the reason that the summits of the Andes in South America are perpetually covered with snow, though exposed to the direct rays of the sun in the torrid zone?

2. What is the reason that high pressure steam, issuing with violence from the safety-valve of a steam-engine, will not scald, while steam of a much lower temperature, escaping from the *stroop* of a common kettle, scalds severely? and why is the steam in the former case seen the instant that it comes in contact with the atmosphere, whereas that from the tea-kettle is invisible for some time?

D. M'L.

R. F. states, that, according to numerous observations made at the University of Halle in Germany, lightning darts from east to west, and from west to east, but seldom in any other direction, and inquires why it does not dart also from north to south, and *vice versa*.

'A Friend to the Arts of Great Britain' thinks, that if magnetic needles were made from iron ore, found in different latitudes, they might give some results that would perhaps lead to the discovery of some of the causes of their variation.

Petrifaction Ponds.—The following is a description of the petrifaction ponds at Shirameen, (a village near the lake of Ourmia in Persia,) which produce the transparent stone known by the name of *Tabriz Marble.*—This natural curiosity consists of certain extraordinary pools or plashes, whose indolent waters, by a slow and regular process, stagnate, concrete, and petrify, and produce that beautiful transparent stone, commonly called Tabriz Marble, which is so remarkable in most of the burial places in Persia, and which forms a chief ornament in all buildings of note throughout the country. These ponds, which are situated close to one another, are contained in the circumference of about half a mile, and their position is marked by

confused heaps and mounds of the stone, which have accumulated as the excavations have increased. On approaching the spot, the ground has a hollow sound, with a particularly dreary and calcined appearance, and when upon it, a strong mineral smell arises from the ponds. The process of petrifaction is to be traced from its first beginning to its termination. In one part, the water is clear; in another, it appears thicker and stagnant; in a third, quite black; and in its last stage, it is white, like a hoar-frost. Indeed, a petrified pond looks like frozen water, and, before the operation is quite finished, a stone slightly thrown upon it breaks the outer coating, and causes the black water underneath to exude. Where the operation is complete, a stone makes no impression, and a man may walk on it without wetting his shoes.

Wherever the petrifaction has been hewn into, the curious progress of the concretion is clearly seen, and shows itself like sheets of rough paper placed one over the other in accumulated layers. Such is the constant tendency of this water to become stone, that where it exudes from the ground in bubbles, the petrifaction assumes a globular shape, as if the bubbles of a spring, by a stroke of magic, had been arrested in their play, and metamorphosed into marble.

The substance thus produced is brittle, transparent, and sometimes most richly streaked with green, red, and copper-coloured veins. It admits of being cut into immense slabs, and takes a good polish. The present royal family of Persia, whose princes do not expend large sums in the construction of public buildings, have not carried away much of the stone; but some immense slabs which were cut by Nadir Shah, and now lie neglected among innumerable fragments, show the objects which he had in view. So much is this stone looked upon as an article of luxury, that none but the king, his sons, and persons privileged by special firmen, are permitted to excavate; and such is the ascendancy of pride over avarice, that the scheme of farming it to the highest bidder, does not seem to have ever come within the calculations of its present possessor.

D.

Proceedings of the Glasgow Mechanics' Institution.

At the adjourned meeting of the Glasgow Mechanics' Institution which took place, the ballot votes of the members were taken on the question—Whether the Lecturers should have any share in the public meetings of the Institution. The decision, we have since learned, was in the negative; the votes being 401 against 135. No new discussions of importance took place; and therefore, with the pressure of matter which we have, we think it unnecessary farther to report the proceedings of this meeting.

NOTICES TO CORRESPONDENTS.

D. A. N. will find a note at the Publisher's. The rest of J. S.'s communication will be inserted next week. Several communications are under consideration; some will be inserted, others will be answered next week.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement which is the subject of their notice.

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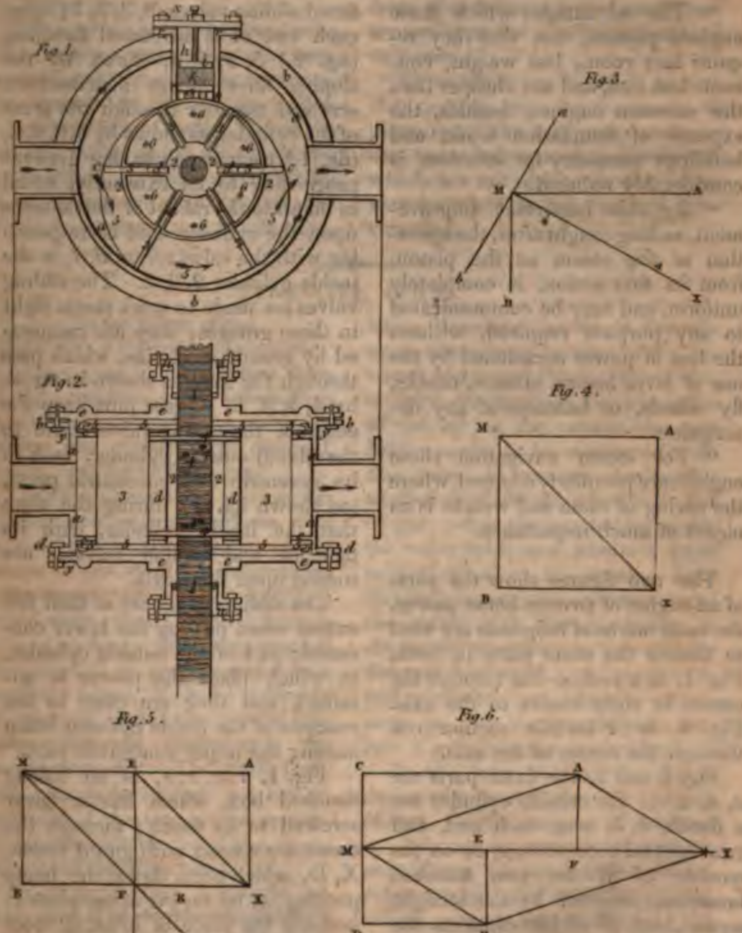
THE GLASGOW
MECHANICS' MAGAZINE.

" For all Copernicus can say,
We'll not believe that every day,
The earth does round her axis reel,
Like whirliegig, or spinning-wheel."

No. X. *Saturday,* 6*th March,* 1824. Price 3*d.*

PATENT ROTATORY STEAM ENGINE.



PATENT ROTATORY STEAM ENGINE.

Description of a Patent Rotatory Steam Engine, manufactured by JOB RIDER & Co. *Belfast.*

THE advantages of this engine, above the common one, are stated by the Patentee in the following words, in a letter to the Editor of the Quarterly Journal of Science:—

"The advantages which these engines possess, are, that they require less room, less weight, consume less fuel, and are cheaper than the common engine; besides, the expense of foundation work, and buildings necessary for erection, is considerably reduced.

"By this important improvement, so long sought after, the operation of the steam on the piston, from its first action, is completely uniform, and may be communicated to any purpose required, without the loss of power occasioned by the use of lever beams, crosses, cranks, fly wheels, or balances of any description.

"For steam navigation these engines are peculiarly adapted, where the saving of room and weight is an object of much importance."

The two figures show the parts of an engine of twenty-horse power, the same marks of reference are used to denote the same parts in both. Fig. 1, is a section cut through the centre at right angles to the axis. Fig. 2, is a middle section cut through the centre of the axis.

Fig. 1 and 2, the fixed parts are *a, a, a, a;* the outside cylinder has a flanch, *b, b,* near each end, and two internal eccentrics, *c, c;* on the outside of it are two flanched branches, denoted by the straight arrows, one of which connects the engine with the boiler, the other with the condenser. It is covered with two ends, *e, e, e, e,* (as shown in fig. 2,) each end having a centre flanched branch, into which is fitted a flanched socket, D, D, screwed down on hemp packing, shown by the dotted shade.

The revolving parts are 1, 1, the inside cylinder, (which is fixed on the axis 2, 2, 2, 2,) has six cavities, or interstices, *d, d, d,* into which are fitted sliding valves, 3, 3, 3, 3; upon each end of it are fitted flanches, (fig. 2,) 5, 5, 5, 5, shown by the sloping lines; these flanches are screwed together through the arms of the cylinder, as shown by 6, 6, 6, 6, (fig. 1,) each flanch having grooves proceeding to its extremity, equal in depth to the rabbet of the flanches upon the cylinder, and corresponding with the valve recess *d, d,* in the inside cylinder 2, 2, 2. The sliding valves are made to work steam tight in these grooves; they are connected by ground steel pins, which pass through the axis, as shown in fig. 2, by 4, 4, 4, 4. These pins keep the edges of the sliding valves close to the (fixed) outside cylinder, both in its eccentric and concentric parts, (as shown fig. 1,) during the time that the inside cylinder, with its flanches and sliding valves, are turned upon their axis.

The sliding valves are at their full extent when passing the lower concentric part of the outside cylinder, at which place the power is obtained, and they are close in the recesses of the inside cylinder when passing the upper concentric part.

Fig. 1, *r, r, r, r,* is an oblong flanched box, which has a cover screwed to its flanch; through the cover are screws with guard rivets, X, D, which press down the hemp packing, *h,* by means of the plate 1, keeping the piece of brass, *o,* close to the inside cylinder 2, 2, 2, 2.

The ends of the piece of brass, *o,* come close to the inside of the re-

volving flanches, and a packing is completely formed between the outside of the upper concentric part, (in the eccentric C, C,) and the inside of the revolving flanches 5, 5, 5, 5.

Fig. 2, *y*, *y*, are sections of rings kept close to the outside of the revolving flanches 5, 5, 5, 5, by spiral springs placed in the thick part of the cover *e*, *e*, *e*, *e*.

The engine is placed between the boiler and condenser, the boiler producing, and the condenser destroying, steam. It has on the boiler-side a pressure of steam, and on the condenser-side nearly a vacuum, the steam-guage standing at six inches of mercury more than the pressure of the atmosphere, and the vacuum-guage standing at 26 inches less. This gives a power of 16 pounds on the square-inch.

The course of the steam gives a velocity of 600 feet per minute of a revolving motion, to the extremity of the sliding valves, and forces round the inside cylinder 2, 2, 2, 2, and the shaft I. In fig. 1, the arrows show the course of the steam from the boiler to the condenser, according as the engine is connected to them.

The engine can be made so that the motion may be reversed at pleasure. The air-pump and under work belonging to the engine, which are not shown in the plate, may be made on the common construction.

ON OIL GAS.

To the Editor of the
GLASGOW MECHANICS' MAGAZINE.

SIR,—Your Correspondent, from Moffat, requests some information on a subject to which the public attention has of late been directed, that is, lighting with oil gas.

I shall endeavour to answer his queries, and state a few facts, that he may the better understand the nature of this mode of illumination.

In answer to his first query, I would state, that I believe there is little or no danger to be apprehended from a small oil gas apparatus in a dwelling-house, if it be properly constructed, and if the person who makes the gas understands the management of it. The smell, however, cannot be entirely got rid of, especially if the size of the apparatus be considerable, or if the apparatus itself be often used.

To query second, it may be replied, that Dr. Fyfe's apparatus is not at all suited to give 20 cubic feet of gas per night. To accomplish this, the retort would require a small furnace for itself, with regulating dampers, (as much depends upon the proper heating of the retorts,) and an oil cistern, fitted with a valve, to regulate the admission of the oil to the retort; the gas-holder ought to be connected with this valve, to prevent the farther admission of the oil when it is full of gas; when the gas-holder sinks, the valve rises, and admits a fresh supply of oil to the retort. In a dwelling-house, this connection of the valve with the gas-holder is absolutely necessary to prevent the disagreeable smell. A condenser, and a washer, are likewise necessary, to pass the gas through, before it gets into the gas-holder.

In the large works, the gas is commonly passed through the oil cistern, for the purpose of washing it. I do not approve of this method, as it leaves, among the oil, carbonaceous matter, and other impurities, which, passing repeatedly into the retorts with the fresh oil, in time increase so much, as at last to hurt the oil and impair the quality of the gas.

To the third query, I answer in the affirmative.

To the fourth query, the answer must be indefinite. The cost of a good oil gas apparatus will vary according to circumstances; the price of the smallest sized patent apparatus, intended for dwelling-houses, is £50, independent of the cost of the gas-holder, which is not furnished by the patentee.

In the decomposition of oil, for the production of gas in the oil gas-works, the following products, besides the gas, are obtained:

In the condenser are found a black unctuous substance, volatile oil, and very impure vinegar, or acetic acid. In the retorts, are found lamp-black, and a pitchy substance, which is formed in the cooler parts. These products are formed by the imperfect decomposition of the oil in the retorts. From the impracticability of decomposing the whole of the oil,* it must be obvious, that less light is obtained from oil when made into gas, than when burned in a good argand lamp. Therefore, Mr. Editor, I would recommend the old oil gas apparatus to your Correspondent, that is, good argand lamps, in preference to Dr. Fyfe's, or any other modern oil gas apparatus, especially for a private house; as they will be more easily managed by servants, and with less trouble, than by attending on a furnace and retort, with any appendages whatever.

* The same difficulty occurs in the distillation of pit-coal in retorts. A great part of the gaseous substance of the coal is converted into tar, essential oil, or naptha, and ammoniacal liquor; which, with the exception of the azote and oxygen in the ammoniacal liquor, form, with the remainder, the constituents of the gas. Could the whole of the gaseous matter of the coal, in the retorts, be converted into gas, a great nuisance *would be got rid of*, and a corresponding *increase of revenue* would result to the *proprietors of these works*.

The nature of the smell, (of which, I noticed in reply to query first, it was impossible to keep an apparatus entirely free,) varies, of course, with the substance of which the gas is made. Whale oil, for example, gives a sharp pungent smell; tallow, or fat, a heavy smell, resembling that of a burning bone.

It is frequently asserted, that oil gas does not smoke nor heat the apartments like coal gas. This is easily accounted for. The consumers of coal gas pay a certain sum yearly for every burner. They, therefore, generally consume as much gas as the apertures of their burners will admit, which is often double or triple the quantity which their apertures were fitted for burning. If they are told they are burning the gas too high, they commonly answer, that it is all paid for; although, in the next breath, they will complain of the intolerable heat and smoke, of which their own heedless extravagance has been the occasion. Oil gas, on the contrary, is sold by measure; and, on this account, as well as from its being three or four times the price of coal gas, more economy is observed in its use; it is thus never allowed to smoke.

The tendency to smoke is in exact proportion to the illuminating quality of the gas; hence, if the gas from pit-coal, cannel-coal, and oil, be successively burned from an aperture that will just allow the gas from common coal to smoke, the smoke of gas from cannel-coal would be doubled, and that from oil gas tripled.

The effect of heat, when each of these gases is properly burned, that is, when each gives equal light, will be just the reverse, or in the proportion of—oil gas, 1; cannel-coal, 2; and common coal, 3.

I am, Sir, your's respectfully,

N. T.

Glasgow, 26th Feb. 1824.

On the Mechanical Advantage of Mr. Cross's Machine.

To the Editor of the
Glasgow Mechanics' Magazine.

Sir,—In Mr. Duncan's Essays on Weaving, the action of the simple, on the tail of a harness, is said to be "in the same ratio as a weight fixed to a moving pulley, suspended by a rope passing through the pulley, and of which rope one end is made fast." That there is no analogy between the arrangements or effects in the two cases, Mr. Murphy shows in his work now publishing; after which, he proceeds to prove that a tail may be lengthened so that a weight, very little more than the net sum of all the weights, attached to any portion of the harness, would be sufficient to pull them up; whereas, according to the opinion of Mr. Duncan, it would require two to one. Mr. Murphy is also in a mistake.

In No. VI. of your Magazine, (page 85,) it is clearly shown, that a weight, less than what is attached to the harness, will be sufficient to make the shed. The account of the harness there given, is, perhaps, the most perspicuous that can be given, and far exceeds any thing I have ever read on the subject.

But though, as there stated, the tail be "stretched out horizontally," yet, at the point where the simple is fixed, it is always depressed several inches below the horizontal line. Let us consider how this depression affects the ratio of action between the simple and tail.

Suppose the mean length of the tail, without the box, to be 126 inches, and that the simple is fixed at 2-3ds of that length, or 84 inches from the end; and suppose the tail to be horizontal, or not held down by the simple. Then it is evident, that, while the harness is at rest, no force whatever is exerted on the simple; but, the moment the pulling commences, the action must also commence, and go on, increasing, till the shed is formed.

When the shed has risen four inches, that portion of the tail, between the box and the simple, will be lengthened so much. In this case, the tail-cords, which go over pulleys level with the other end of the tail, will form an angle with the horizon, of about 19 degs. 20 min. and their other ends, about 10 degs. 25 min. Now, it is demonstrable, that, when three forces are in equilibrio, they are proportional to the three sides of a triangle formed by lines drawn parallel to the directions in which these forces act. Therefore, if we represent the force exerted by the weights attached to the harness, by 100, the weight supported by the tail-stick will be 96, and the force exerted by the draw-boy 51.

But suppose, what is nearer the truth, that the tail is tied, with an angle of 7 degs. at the pin, and 14 degs., as the mean, at the box; then a triangle, formed of lines parallel to the directions of these forces, will have sides proportional to 100, 98, and 36. The first, as before, representing the leads; and the last, the force exerted upon the simple. When the shed has risen four inches, as before, the mean angle, at the box, will be about 24 degs.; and, at the pin, about 12 degs. 30 min. The sides of a triangle, now formed, will be as 100, 94, and 61.

These numbers are not the most accurate; the operation being performed by Gunter's Logarithmic Scale;* yet they serve to show the

* These numbers are extremely near the truth, to have been calculated by the scale. To ascertain their accuracy, we calculated them by the tables, and obtained the following results:—For the first triangle, 100, 95.94, and 50.45;

wide difference of the ratios of action, from those which are stated by Mr. Duncan and Mr. Murphy. At the same time, they also show us a very material difference between Mr. Cross's machine and the old harness. We see, from these numbers, that, in raising the shed on the old harness, while the tension of the warp increases, the mechanical advantage is rapidly decreasing. Now, in Mr. Cross's machine, while the tension increases, the mechanical advantage increases also.

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for the second, 100, 97.76, and 36.1; and, for the third, 100, 93.57, and 60.92 nearly.

Another disadvantage, in the old harness, is, that when the pattern is such that the weight is no obstacle, the draw-boy's hand, descending through equal spaces, in equal times, raises the shed more rapidly as the state of tension increases: this has a great tendency to break the yarn. In Mr. Cross's machine, the very opposite of this takes place.

From all these advantages, therefore, I would augur, that, however unwilling the public are to adopt these new machines at present, the time will soon arrive when they will be found in every shop.

S.

Paisley, 11th Feb. 1824.

ON THE FIGURE OF THE EARTH.

It has been the object of true philosophy, in every age, to teach the mind

"To rise from nature up to nature's God."

No science is better calculated to accomplish this grand object, than the ennobling science of astronomy. Here the most spacious mind finds room for its expansive powers, and soaring aloft amid the innumerable worlds, suns, and systems, which this science discloses to its view, is at last so overwhelmed with the magnitude of its own conceptions, that it is soon

"Lost, in wonder, love, and praise."

Such were not, however, the opinions formerly entertained by the generality of mankind, in those ages when ignorance and superstition, with a fatal and irresistible sway, ruled over the fairest portions of the globe. The rude ideas that then generally prevailed respecting the magnitudes, motions, and distances of the celestial bodies, present a wonderful contrast to the astonishing discoveries of modern times. Indeed, to the absurd conceptions which the ancients entertained respecting these bodies, may, in a great measure, be ascribed that moral darkness which so long overspread the world, and which still sullies the pages of its history. Had the Heathen philosophers and poets, instead of ascribing divinity, and paying adoration to the sublime and beautiful objects they beheld in the heavens, rather employed themselves in ascertaining the laws by which they are governed, and in gaining a knowledge of the secondary causes that influence their motions, they would have been led to a true knowledge of that Great Being who commanded them into existence, and who will not allow his glory to be lavished on the creature instead of the Creator.

It is obvious, from the limited nature of man, that the first ideas of those who began to study nature in her most magnificent works, must have been little removed from those of the most unlearned. Accordingly, we find the opinions that have

come down to us, of some of the most distinguished ancient philosophers, are very different from those that prevail at the present day.

To an observer who turns his attention, for the first time, to the phenomena which nature has thrown all around him, the surface of the earth seems to be of unbounded extent, and of the most irregular form; here, rising into lofty mountains and ridges of hills; there, stretched into vast plains, vallies, and desarts, or diffused into a boundless expanse of waters; while all the rest of the universe, consisting of sun, moon, stars, and planets, appear to him, as bodies moving in the one-half of the concave surface of a sphere, whose base he conceives to be the plane of the earth.

This first and most natural opinion, though generally believed, was, however, accompanied by the crudest ideas, and the wildest fancies, which the mind could possibly conceive, and which led men to imagine they saw and heard things utterly impossible. Thus, the Latin poet Lucan represents the Roman army, when on the western boundary of the great continent, (called, from this circumstance, Finisterre), as hearing the sun rushing with a hissing noise into the ocean. Others, again, have spoken of an immense cavity in the remotest parts of the east, from which the sun was heard issuing every morning with an insufferable noise. Another philosopher represented the earth as an immense plain, environed by an impassable ocean; in this plain stood a huge mountain on the north, around which the sun and stars performed their diurnal revolutions; and from the comical shape of this mountain, and the oblique motion of the sun, he accounted for the inequality of the days, and the variations of the seasons. The vault of heaven leaned upon the earth that was extended beyond the ocean; which was supported on two vast columns, and beneath the arch, angels conducted the motions of the stars. Above this were the celestial waters, and above all were placed the highest heavens.

Various other opinions, equally impossible and absurd, have been held respecting the figure, extent, and motion of the earth. One supposed it was extended infinitely downwards to account for its stability; another, that it existed in the form of a cylinder, or drum; a third, that it was scooped, or hollowed out in the shape of a boat; all which suppositions are so futile, and so destitute of any foundation in nature, that they require no refutation.

Pythagoras, an ancient Grecian philosopher, was the first who taught the true motion of the planetary bodies. He and his followers maintained, that the earth moved daily round its axis, and revolved annually round the sun; that every star was a world, and that each of them was surrounded by an atmosphere like ours; that the moon was inhabited by larger and more beautiful animals than those which exist on the earth. They seem even to have had some idea of universal gravitation, but this was obscured under the doctrine of the harmony of the spheres.

These opinions, though mixed with error, were much nearer the truth than those to which they were soon obliged to give way, because they were not so agreeable to the first impressions of mankind.

During the reign of the Aristotelian philosophy, every opinion which was in opposition to its doctrines was overwhelmed, and thus the Pythagorean system of the universe was lost amid the general ruin.

The Ptolemaic system which fol-

lowed, and was generally received by philosophers with various modifications, prevailed till the time of Copernicus, in the beginning of the 16th century. The followers of this system, which was most accommodated to vulgar prejudices, held, that the earth was the centre of the universe, and around it, the sun, the planets, and all the fixed stars performed their revolutions. To account, on this hypothesis, for the phenomena, they observed, was no easy task; and, accordingly, they introduced such difficult, complicated, and absurd theories into their system, and in the words of the poet,

> ———— " how build, unbuild, contrive
> To save appearances; how gird the sphere
> With centric and eccentric scribbled o'er,
> Cycle and epicycle, orb in orb,"

that nature herself groaned, as it were, under the intolerable burden.

Copernicus, who, on the revival of learning, had his attention particularly turned to the study of astronomy, was quite dissatisfied with the Ptolemaic system, even though modified by that of Tycho Brahe, and after a long and laborious inquiry into the planetary motions, revived the ancient Pythagorean hypothesis. This system, which now rests on the irrefragable basis of mathematical demonstration, was gradually extended and improved by the labours and discoveries of Kepler, Galileo, and a host of illustrious astronomers who succeeded Copernicus, till at last it was perfected by the immortal Newton.

The rotundity of the earth is commonly proved by the following arguments. The first argument which may be adduced, is derived from the apparent motions of the heavenly bodies.

To the eye of an observer on the earth, the whole concave vault of heaven, bestudded, as it is, with innumerable luminaries, " all differing from each other in glory," appears to revolve continually round the earth, from east to west, in the same period of time. There are, however, two points in the heavens which seem for ever to remain at rest, in this diurnal revolution. These fixed points, denominated the north and south poles, are discovered by certain stars in their vicinity, which seem to have scarcely any motion when compared with those at a greater distance. Now, whether the earth be plane, or spherical, it is evident, that, to an observer, on any part of its surface, the heavenly bodies will still appear uniformly to rise in the east, and continue rising till they reach the meridian or highest point, then to descend, and continue descending, till they totally disappear in the west. But, if the observer travel from north to south, in the meridian line, he will find the northern stars disappearing, and the southern stars coming into view; while those which remain in sight appear much higher when they reach the meridian than before, and that by equal degrees in the heavens, if he proceeds by equal distances in his journey on the earth.

If he travel till he comes to the equator, then both the poles will appear to him in the horizon; and if he proceed north or south, he will find either pole gradually rising till it come to the zenith, when the stars which were in his zenith at the equator will now appear in the horizon. If, when at the equator, he should advance directly east, he would find the stars, and other luminaries, gradually rising sooner every day, and exactly in proportion to the daily progress he would make. If he proceeded westward, he would find the case exactly reversed; that is, they would rise proportionably later, as he continued by equal degrees on his journey.

Now, all this would be impossible,

e earth a plane, or any other ot spherical; for, on what- int in the surface of a plane ever may be situated, still he ee the same luminaries, and ever see any others; and we y the principles of geometry, degrees of distance on the ould by no means correspond ose in the heavens, which uniformly found to do. In o other figure, but that of a will correspond to the fore- ppearances, and others that en actually observed.

second, and plainest argu- or the globular figure of the is derived from the figure of low being projected on the n a lunar eclipse; for, this being always bounded by of a circle, it necessarily fol- hat the earth which projects st be of a spherical figure. earth were a plane, it is ob- that the shadow would, some r other, appear as a straight the moon's disk, or most ot be seen at all. If there ny remarkable angle, or very rable irregular protuberance earth, it would, on some n or other, appear by the r. But it may be said, why the Alps, the Pyrenees, and y Cordilleras, appear as small ions on the face of the moon? nswer is simply this, that ountains, compared with the se body of the earth, are as s grains of sand or dust are, compared with the artificial globes that are usually made to represent it; a fact which is demonstrable by actual measurement.

The third argument is drawn from analogy. We observe the sun, moon, and all the other planets, to be of a spherical form. This is discovered by their rotation on their axes, a fact which is incontestibly proved by the motion of spots on their surface. Hence it is evident, that our planet, when viewed from the surface of any of the other planets, must appear also to be of the very same form, and to have a similar rotation discoverable by spots on its surface.

The fourth, and last argument that we shall adduce is, that the earth has been frequently circumnavigated, and, consequently, must be spherical. The first who performed this arduous task, was Magellan, who, in 1519, set out on the west side of Spain, and shaping his course westward, discovered the straits that are called by his name, and returned in 1124 days, to the eastern side of the country whence he had set out. After him, it was performed by Drake, Dampier, the illustrious Cook, and many others; all bringing such a flood of testimony, to prove that the earth is a globe, that there is no longer any doubt of the fact.

Other arguments might be adduced from the rotatory motion of the earth, but as this subject has not yet been touched upon, they are deferred till another opportunity. N.

IPENDIUM OF MECHANICS; or Text-Book for Engineers, Mill-Wrights, Machine-Makers, &c. &c.; by ROBERT BRUNTON.*

is a very useful publication, calculated to supply a great ratum amongst operative mechanics. The work is professedly a compilation, and it seems to have been selected with very considera-

* John Niven, Jun. Trongate, Glasgow. pp. 132.

ble skill, and with a constant view of practical utility. The explanation of the mechanical powers are given shortly, but distinctly, and the rules for calculating their effects are expressed in the same manner. Very appropriate examples are given under each head, and the calculations are exhibited in the most concise form, at the same time that they are sufficiently obvious to any person who is acquainted with common arithmetic. Indeed, it is in this respect that we think this publication is calculated to be of the greatest use to mechanics, because, in it they have not only the rules, but their application to practical questions, the want of which is frequently felt in larger works on the subject, which generally contain a more extended elucidation of the principles, and but little of the practice.

These rules, however, simple though they be, are not calculated to give, in most cases, the real results which must occur in practice; because neither the resistance of friction, nor the weight of the instrument, are taken into account. We are aware, that it is difficult to estimate these, and that a proper and just mode of estimating them in all cases, is a desideratum. We certainly did not expect to find these deficiencies wholly supplied in this work, which is merely a text-book of the general rules that have been long ascertained; but we think the author should have adverted to them, lest his readers should, upon the application of any of his rules, find that they will not, in all cases, give the result which may occur in practice, and thereby shake their confidence in the accuracy of those rules. In no case, are these considerations more obviously necessary, than in that of the screw, where the friction of the instrument requires frequently as much force

or power to overcome it a
weight to which it is ap
Indeed, it may be said, th
friction of this mechanical p
is the principal agent by whi
most cases, it operates.

The work contains, in wha
lows, the results of the lates
most accurate experiments o
cohesive strength of materials;
practical problems on the trans
strength of wood and iron b
bars, &c.; also, on the streng
the journals of shafts, with
strength and velocity of w
&c., interspersed with some
useful tables on these subjects
few good practical examples
given under the centres of gr
percussion, and gyration; thoug
think the author has not enlarg
these subjects so much as he
have done. The problems relati
the regular figures, and particula
the circle, should have been e
plified. It is true, that the
are given, but examples sh
have followed.

We have the same objecti
the rules of mensuration, p
at the commencement of the
lume. To a person acqua
with the rules in some me
before, they will be of com
atively little use, as he must
the most of them in his mem
To one unacquainted with t
they will be of as little use
cause he will be unable to
them without examples, unle
more than ordinary share of p
verance and industry has falle
his lot.

The doctrine of central f
is next very shortly applie
fly-wheels. The observations
rules relative to the steam en
appear very useful, and founde
long practice. Water wheels
pumps are next elucidated: and
volume concludes with some
useful miscellanies and tables.

We had almost omitted to mention, that the rules for specific gravities with tables of the same, for falling bodies, and for pendulums, are very well explained, and are, in our opinion, the best executed of the whole. We confess, we did not see much use in prefixing the tables of weights and measures, but particularly the French system, to this volume, for we do not think that they are employed in any part of the work. Upon the whole, however, it possesses considerable merit in the arrangement and elucidation, and will form a very useful note-book to the ingenious mechanic.

THE PRINCIPLES OF NATURAL, OR MECHANICAL PHILOSOPHY.

No. VI.

Statics.

PROPOSITION.—*If any two forces be represented in magnitude and direction by the sides of a parallelogram, their resultant will be represented in magnitude and direction by the diagonal of the parallelogram.*

Case 1.—Let the composants form a right angle, then the resultant will be equal to the diagonal in magnitude.—Let the forces A and B, (fig. 3,) be represented in magnitude and direction by the lines M A and M B, forming a right angle A M B, and let X, their resultant, be represented by M X; the straight line M X will be equal to the diagonal of the parallelogram formed by M A and M B, in magnitude. For, let the force A be resolved * into two composants, A and a, proportional to the original forces A and B, and let their direction and magnitude be represented by M A and M a, the one a part of M X, and the other a perpendicular to it. In like manner, let the force B be resolved * into two composants, B and b, proportional to the original forces, and let their direction and magnitude be represented by M B and M b, the one a part of M X, and the other a perpendicular to it. We shall then have these four analogies:

$$X : A :: A : A = \frac{A^2}{X}$$

$$X : B :: A : a = \frac{AB}{X}$$

$$X : B :: B : B = \frac{B^2}{X}$$

$$X : B :: A : b = \frac{AB}{X}$$

Where, by dividing the product of the means by the one extreme, we have expressions for the other extreme in known quantities. Now, the two forces, A and B, have been resolved into the four, A, B, a, b, which have been found equal to the four,

$$\frac{A^2}{X}, \frac{B^2}{X}, \frac{AB}{X}, \frac{AB}{X},$$

of which the two last are equal; and, being contrary, destroy each other. † Hence, the two forces, $\frac{A^2}{X}$ and $\frac{B^2}{X}$, are equivalent to the two A and B, whose resultant is X, and the two former act in the same direction M X, and are represented by the line M X. Therefore, ‡

$$\frac{A^2}{X}+\frac{B^2}{X}= X, \text{ or } A^2+B^2 = X^2.$$

* Postulate 2. † Axiom 1. ‡ Axiom 2.

That is, the resultant of two forces acting in a right angle, is represented in magnitude by the diagonal of the rectangle. Q. E. D.

Case 2.—Let the composants be represented by the sides of a square, their resultant will be represented in direction as well as in magnitude by the diagonal.—Let the two equal forces, A and B, (fig. 4,) be represented in direction and magnitude by the sides M A and M B of a square, their resultant X, will be represented in direction and magnitude by the diagonal M X. For, complete the square, then the resultant must bisect the angle;* and it has been shown in the preceding Case, to be equal in magnitude to the diagonal which also bisects the angle, and consequently coincides with it. Therefore, the resultant must pass through the point X, and be represented both in direction and magnitude by the diagonal M X. Q. E. D.

Case 3.—Let one of the composants be double of the other, and let them be represented by the sides of a rectangle, then their resultant will be represented by the diagonal of the rectangle.—Let the force A be double the force B, (fig. 5,) and let them be represented by the lines M A and M B, the sides of the rectangle M A B X; their resultant, will be represented in direction by the diagonal M X. For, let the force A be resolved into two equal forces † acting in the same direction, namely, the line M A; and let the one be considered as acting at M, represented by the line $ME = \frac{1}{2} MA$, and the other at E, represented by $EA = ME = MB$.‡ Complete the square E B, and draw its diagonal M F, which, by the preceding Case, will represented the resultant of the forces E and B, both in direction and magnitude; let this resultant be the force G, and consequently acting in the direction M F G. Let the force G be now resolved into two equal forces, H and K, and acting in parallels to the directions M E, M B; that is, in the lines B F K, E F K, respectively, and consequently forming the right angle H F K. Now, let the force $H = B$,‡ act at the point E, and consequently represented by E F; then complete the square F A = the square B E, and draw its diagonal E X, which, by the last Case, will represent the resultant of the forces represented by E F and E A, both in direction and magnitude. Again, let the forces represented by F X and E X, namely, the force K, and the resultant of the forces H and E A, be supposed to act from F towards X, and from E towards X, respectively, then their resultant must pass through X; but it must also pass through the point M, where the two original forces, A and B, were supposed to act; therefore, the diagonal M X must be the direction of the resultant of these two forces, A and B; and it has been already proved, that it represents it in magnitude. Q. E. D.

Case 4.—Let the two forces be represented in direction and magnitude by the sides of any parallelogram whatever, the diagonal will represent their resultant.—Let the lines M A and M B, (fig. 6,) forming any angle, A M B, represent the forces A and B, having any proportion to each other. Complete the parallelogram M A X B, and draw the diagonal M X; then M X will represent the resultant both in direction and magnitude. Through the points A and B, draw the perpendiculars, A F and B E, to the line M X, and complete the rectangles F C and E D. Then will M A be the diagonal of F C, and represent the resultant of two forces, C and

* Corollary 1. † Corollary 2. ‡ Postulate 3.

F, equivalent to the force A, the one acting in the diagonal M X, represented by M F, and the other in a perpendicular to it, represented by M C; in like manner will M B, the diagonal of E D, represent the resultant of two forces, D and E, equivalent to the force B, the one acting as before, in the diagonal M X, represented by M E, and the other in a perpendicular to it, represented by M D. Now, because the angle M F A = the angle B E X, and the angle A M X = the angle M B X, and the side M A = side B X, the triangle M F A = the triangle B E X; therefore, F A = B E, and E X = M F; but F A = M C, and B E = M D; therefore, M C = M D, and they represent the two forces, C and D, both acting from the point M; consequently, they are equal and contrary forces, and therefore destroy each other. There now remains the two forces, E and F, both acting in the line M X, and represented by the lines M E and M F; now M F = E X, and M E + E X = M X; therefore, M E + M F = M X. Hence, the two forces, E and F, are equal to the single force X; but the forces E and F, are equivalent to the forces A and B; therefore, the force X is the resultant of the forces A and B, and it is represented both in direction and magnitude by M X, the diagonal of the parallelogram M A X B. Q. E. D.

(To be Continued.)

To use the words of a Correspondent, we shall apply this theorem to the solution of K.'s query, in No. VI. page 94.

"By the cord being brought over the pulley, and fastened to the wall, so as, at the pulley, to form a right angle, it is evident, that the pulley is acted upon by two forces, each equal to the weight of 10 lbs., one of them acting in the direction of a line parallel, and the other in the direction of a line perpendicular to the horizon.

"Now, by the 47th of the 1st of Euclid, $M A^2 + M B^2 = M X^2$, (fig 4.) If, therefore, M A and M B are equal to 1, M X will be equal to $\sqrt{2} = 1,4142$ nearly. But the spaces described by the same body in equal times, are proportional to the forces impressed. Therefore, the force impressed upon the pulley, when acted upon by both forces, is to either of the forces, as M X is to M A or M B, that is, as 1,4142 is to 1. But the forces acting upon the pulley are each of them equal to the weight of 10 lb., therefore, the pressure upon the pulley is to 10 lb. as 1.4142 nearly, is to 1.

"Hence, it follows, that the pulley sustains a pressure equal to the weight of 14.142 lb. nearly, and that this pressure is in the direction of a line inclined to the horizon, at an angle of 45 degrees, or half a right angle."—J. D. C.

The result of the preceding demonstration and elucidation, may be more simply expressed thus:—*When a body is acted upon by two equal forces, acting at right angles to each other, the effect is the same as would be produced by a force equal to the square root of twice the square of the number denoting either force, and acting at an angle of 45 degrees, with the line of direction of either force.* Hence, to find the resultant of two such forces—*Square the numbers denoting each, add them together, and extract the square root; this root will be the number denoting the resultant of the two forces.* Hence, in the above case, $\sqrt{2 \times 10^2} = \sqrt{200} = 14.14$, &c. the weight sustained by the pulley.

The above solution by J. D. C.

being the only one we have received, we cannot avoid expressing our surprise that none of the Mechanics of this city should have thought proper to send a solution of this question. Have they not frequently heard the parallelogram of forces explained and exemplified, in Anderson's Institution? And might they not have applied the instructions they received there, to its solution? We are afraid that the same listlessness and inactivity, which we have frequently observed in some of the students of that Institution during the delivery of the lectures on this subject, by the learned Professor, have also overtaken many of our readers, who must have repeatedly heard these lectures; otherwise they should have been perfectly able to send a proper solution. Perhaps, however, they may have considered the question as too easy; lest this may have been the case, we shall endeavour to remedy the defect, by proposing one a little more difficult:

A vessel carried by the force of the wind, at the rate of 6 miles per hour, N. 35° W., is, at the same time, impelled by a current, at the rate of 3 miles per hour, S. 15° W. What is the actual velocity and course of the vessel?

ORIGIN OF THE GLOBE.

A Correspondent makes the following just remark upon the letter in our last, on the origin of the Globe. Having quoted the passage, "The earth was without form, and void,"—

"The inference," says 'An Observer,' "is, that it was so from eternity." I question not your readers will consider this as erroneous a statement as they have met with—though the earth was without "form, and void," yet it by no means follows that it was so from eternity.—A.

Though our Correspondent has justly found fault with 'An Observer,' yet he has not taken a correct view of the subject in another part of his letter, where he has defended the hypothesis alluded to in Mr. M'Fadyen's introductory lecture,—that the earth existed for a series of ages previous to the period assigned by Moses for its creation. We conceive this opinion as derogatory to the power and glory of the Omnipotent, independent of the express contradiction of Revelation. *Can there be* any thing more simply and plainly stated, than what is contained in the first sentence of the Book of Genesis, *i. e.* the Book of the Generation or Origin of all things? "In the beginning, God created the heavens and the earth, and the earth was without form," &c. How could there be any ages of pre-existence, when the earth was created in the beginning, and at that beginning, was without form and void, that is, had not received that form which it now possesses, but was, as the original signifies, a dark mass of confused matter? Where is there any talk here of creatures, such as the Mastodon and the Polypi, lording these dark domains? The idea is absurd, and insupportable by any serious argument. Geologists had better employ themselves in ascertaining the reality of the existence of some of the boasted organic remains they talk of; and, if there be any reality in them, in referring them to some later date than the pre-existence of the globe; than in endeavouring to impugn the authority of Scripture in order to establish their own fan-

potheses. Derogatory, how- the supposition is, that the xisted prior to the time as- in Scripture, during which d seem according to these series of attempts had been o produce a perfect system gs, but all of which had xcept the last; the notion of bserver' is still more so, as it s the Supreme from having nd in its creation, by the tion that it existed from all eternity. Eternal matter! what an absurd idea. Has Aristotle risen from the tomb, and re-commenced his Peripatetic Lectures, that we should have such Heathenish notions crammed down our throats in this enlightened age? It cannot be. Our Correspondent, the Observer, must have been dozing when he wrote the sentence; and, lest our readers should doze when they peruse our remarks, we drop the subject, with no intention to resume it.

REMARKS ON QUERIES.

EDITOR,—Having observed eral of the queries inserted r Magazine remain un- d, I send you the following on some of them.

o. II. 'An Observer,' in on, has proposed the three g:

'Why does the sun, shin- ngly on a fire, extinguish

want of strong sunshine has ed me from making proper ents. I may state, how- at I tried a fire made of pa- one occasion, when the sun is appearance, and that it d very little flame; but con- imperceptibly away. This ent demonstrated that com- was going on, although the was far from being bright to contend with the king of When a shade, however, was ced between the fire and the e combustion was then ob- going on as well as if the the sun had never reached it. is I conclude, that unless 'An er' affirms, that he has seen put out a candle or fire where bustible matter is not ex- , when exposed to his rays, lains the circumstances that d its extinction, we ought to he fact altogether.

Secondly, 'Why does lightning spoil porter, &c.'

It is known that a stream of electricity, whose identity with lightning has been long established, produces incubation in eggs, when passed through them for some time. The electricity, in this case, acts in the same manner as heat, about 180 deg.; and it is well known, that unnatural heat, such as this is, has the effect upon liquids he mentions. To affirm that the whole mass of beer in the vat of a brew-house is heated, would be saying too much, but that it is electrified by position there can be no doubt, since the restoration of the equilibrium that takes place, after, and all around the *electric discharge*, will take place, also, in the contents of the vat, which are connected by the surrounding matter, by the best conductor; around this point of *exit*, the beer, &c. will be spoiled, and hence the contamination of all the rest. It is not asserted that this is the only action that lightning has on the articles in question, but these few hints may lead some abler Correspondent to write on the subject; and then my object will be attained.

Thirdly, 'Why does a straight edge, at whatever height of level, point to the sea?'

Your querist should first have as-

certained whether it be true that a straight edge points to the sea, since it can easily be shown to be false. In fact, if it were true, all the observations made by navigators, to ascertain the altitude of the sun, are incorrect; for, in those observations, an allowance is made for the height of the mariner above the sea; for which there would be no occasion, on the supposition of our 'Observer.' Taking it for granted, however, that we do see the horizon by looking along a straight-edge placed level, then we must attribute this phenomenon to optical deception. The light must be bent down by passing along, or under the influence of a denser body, the same as light is made to diverge by passing through a hole in a window-shutter, by inflection.

I am, Mr. Editor,
Your's,
R. H.

SIR,—In your Seventh Number, (page 111,) you mention various letters you had received in answer to a query in a former Number, as
to the occurrence of five Sund
the month of February.—Am
the rest, M. M. R. says it occ
1796, and will again every
year, which, you add, is co
to Mr. Boaz's Bill Card.

Now, as any suspicion o
correctness of that little varn
shilling manual, signed by me
seen in the Book-shops, as w
in Boaz & Jeffrey's 5 per Cen
terest Tables, might shake the
lic confidence in it, I beg lea
state, that five Sundays in Feb
happened in 1756, 1784, and
—will happen in 1852, 1880,
not again this century, all a
said Card.

As you seem to have a pr
ing assortment of chronological
respondents, amazingly fond of
pounding questions and expla
puzzles, perhaps some of then
tell when, within the last sc
centuries, two consecutive m
contained only seven Sundays?
when a similar prodigy will
occur?

Your obedient servant,
JAMES

Glasgow, 3d March, 1824.

NOTICES TO CORRESPONDENTS.

WAR *on* TURKEY-*red*.—In the peaceful exercise of our Editorial functions, we hav
unexpectedly alarmed by the din of war. Gentle reader! it is about the discharge of Turke
which, from the fierceness of the combatants, seems to have some chance to end in the disch
Bloody-red. The classical adage,

"When Greek meets Greek, then comes the tug of war,"

may, in allusion to the hostile character of some of our-*Turk*ey-red friends, be properly rendere

"When *Turk* meets *Turk*, then comes the tug of war."

We have received another epistle, defending, in more explicit terms than formerly, the claim
person (yet living) to the invention of the process; and we have since received an entirely *new* sta
of claims, not from any ghost of the deceased claimants, (which, indeed, would have alarmed u
from a living individual, who maintains that *he* is the sole inventor. We must proclaim a tr
least for a week, among the belligerent parties. One of them is at such a distance, that it is im
to substantiate his claims more distinctly; those who are present, are too violent, and they
none the worse of cooling on the subject. We require time to make ourselves such masters
controversy as to devise means for bringing it to a short issue, and thus to perform a duty whi
readers expect of us, that we shall allow such discussions to occupy the shortest possible space
work. Need we add, that, wherever they may obtain admission, no extracts from *confidential*
for the purpose of indulging in personal pique, can be admitted into "The Glasgow Mec
Magazine."——Other Correspondents will be attended to next week.

☞ Contributions received by the Publisher; also, by Messrs. E. West &
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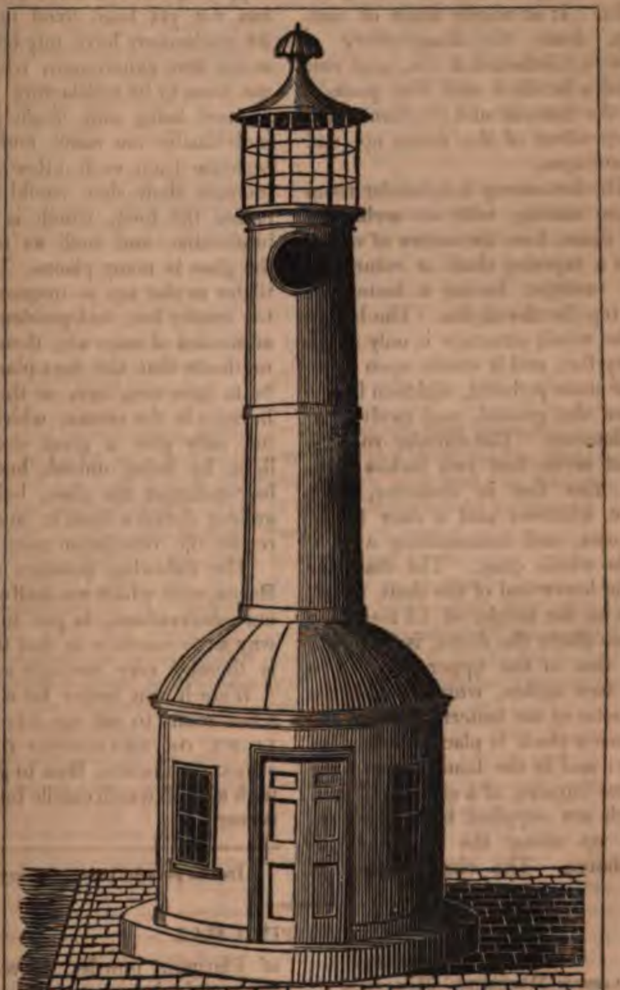
J. CURLL, PR

THE GLASGOW
MECHANICS' MAGAZINE.

"Teach me with Art great Nature to control,
And spread a lustre o'er the shades of Night."—*Young.*

No. XI. *Saturday, 13th March,* 1824. Price 3*d.*

IRON LIGHT-HOUSE ON THE QUAY AT GLASGOW.



IRON LIGHT-HOUSE ON THE QUAY AT GLASGOW.

THIS small, but neat light-house is erected at the western extremity of the Broomielaw Quay, on the river Clyde, at Glasgow, for the purpose of affording light upon the Quay, and preventing vessels, especially steam-boats, from being injured by coming against the breast, when approaching the harbour during the night. It is wholly made of cast-iron, from the manufactory of Messrs. Girdwood & Co., and cost about a hundred and fifty pounds, for the material and erection alone, independent of the fitting up, and appendages.

The first storey is a circular room of one casting, with an architrave and dome, from the centre of which rises a tapering shaft or column of two castings, having a lantern at the top for the lights. The height of the whole structure is only about thirty feet, and it stands upon a circular stone pedestal, eighteen inches above the ground, and twelve feet in diameter. The circular room is about seven feet two inches high, and nine feet in diameter, with three windows and a door facing the east, and commanding a view of the whole quay. The diameter of the lower end of the shaft, which rises to the height of 12 feet nine inches above the dome, is four feet, and that of the upper end, three feet two inches, which is also the diameter of the lantern. Below the lantern a clock is placed, facing the East; and in the lantern, there are 24 gas burners, of a single jet each, which are supplied by a pipe carried up along the inside of the lighthouse. The circular room is lined with wood, and the upper column is furnished with a wooden stair, winding to the top, which must be reached by a trap-ladder, and is barely sufficient to allow a person to ascend to illuminate the lantern.

We understand that the mode of supplying the lantern with lights has not yet been fixed upon; the 24 gas burners have only been tried as the first experiment, which does not seem to be satisfactory. These burners being only single jets, are individually too small, and too far separate from each other; and to increase their size, would only increase the heat, which is already intolerable, and such as to break the glass in many places. The ventilator at the top is unquestionably too small; but, independent of the admission of more air, there can be no doubt that the best plan would be to have one, two, or three large burners in the centre, which would not only give a great deal more light, by being united, but would less endanger the glass, being at a greater distance from it, and would render the ventilation more perfect.

The following question of Lord Bacon, with which we shall conclude our observations, is put in such a way as to convince us that the truth is thereby very strongly asserted: "Were it not better for a man in a fair room to set up ONE GREAT LIGHT, OR BRANCHING CANDLESTICK OF LIGHTS, than to go about with a small watch candle into every corner?"*

* In the present case, "every *pane*."

SELF-IGNITING GAS.

To the Editor of the
GLASGOW MECHANICS' MAGAZINE.

SIR, — The discovery of that beautiful phenomenon, the ignition of Platinum powder, by means of a jet of hydrogen gas, gave rise to a hope, that we might ultimately obtain self-igniting jets for our street

lamps, our churches, and other public buildings, where difficulty and inconvenience occur in lighting the gas. This hope, however, was put to flight, by an assertion, (from a quarter which might be considered good authority in matters of this kind,) that coal gas had no effect whatever on Platinum powder. This opinion, however, has been too hastily adopted, and the lovers of the wonderful may still indulge the hope of seeing, every evening, the thousand lamps of their city, as if by magic, at once start into a bright blaze.

If the Platinum powder be previously heated, it is instantly ignited on the application of a jet of the Glasgow Coal Gas, and continues at a bright red heat, so long as the gas is allowed to play on it; I have not as yet ascertained the degree of heat necessary to induce the Platinum to act on the gas. The method I took to heat it, was, by lighting the gas and allowing it to play for a second or two on the powder, which heated it sufficiently to make it ignite on the application of the cold gas. Self-igniting jets could be very easily made, provided the gas, by some mode of purifying, could be procured, so as to act on the Platinum when cold.—I am, &c.

A MEMBER OF THE GLASGOW PHILOSOPHICAL SOCIETY.

Glasgow, 10th March, 1824.

ON THE RE-BUILDING OF THE NORTH-WEST CHURCH,

Commonly called the RAM'S HORN.

To the Editor of the GLASGOW MECHANICS' MAGAZINE.

SIR,—Since the Magistrates have resolved to pull down and re-build the North-West Church, it will be matter of deep regret to the lovers of the fine arts in this City, if the advantages of the situation are not duly appreciated. Whether we consider its locality in the town, or connection with the adjoining streets, we venture to assert, that there are not two other situations in the City, that present a better opportunity to the architect.

We would lament the *crippled* finish of some of the late built churches, and condemn the mode of procedure that has been adopted, *viz.* that of getting designs for a splendid house, and then cutting them down to suit a stipulated sum, thereby destroying the plan; without taking into account, that, for the saving of three or four hundred pounds, a design for a mass of stone and lime is made up, that ever afterward remains a monument of ill-timed economy, and a discredit to all connected. Now, it ought to be considered, that any little extra expense would be but a drop in the bucket, and that, by incurring it, the building would be erected in the finest style, and, as it should be, an ornament to the city; whereas, for the saving of such a small sum, there is reason to fear, that so long as one stone of the building remained upon another, it would be looked upon by all (to say the least of it) with a feeling of dissatisfaction.

The Magistrates and Council would do well to begin, and continue a liberality, that will enable their architect to finish the North-West Church in a style worthy of this enlightened and liberal town, without being burdened by contracted and mean views of individuals, and to see such a design adopted and completed, as will remain a monument of the taste of the present day.

Suppose that an elegant portico, of four fluted Ionic columns of

thirty-five feet in height, be placed in front of the building, of the finest proportions, and purest style of Grecian design, surmounted with entablature and pediment. Let the antæ be carried round the church, and coupled at the corners, having the whole raised on a pedestal of just proportions, by which the floor of the church would be raised to a height sufficient to admit of burying layers below. Let the ascent to the floor be by an elegant flight of moulded shallow steps; and by this means a splendid front would be obtained. Let the entrance hall be of a large circular, or oval plan, and at least thirty feet high in the ceiling, with the stairs right and left, and corresponding; and the landings connected with each other by a railed balcony across the hall. Let the church itself be of acknowledged proportions, and finished in a style to suit the other parts of the building.

The spires of Hutcheson's Hospital, of the College, and of the North-West Church, along with some others of the town, present a crowded appearance, and give the idea of the public buildings being huddled together. To avoid this, in the new plan, and give a finish to the building in a grand style, let a well-proportioned dome be built over the entrance hall, finished with a lantern, and enriched in the same style as the front.

This building, executed by a man of taste, who would preserve unity and concord throughout the whole, would be the most handsome building in the town at the cost.

There is no style of town buildings that can be compared to a well designed edifice in the Grecian style; the noble column, and massive entablature, gives a simple magnificence to the whole, and calls forth the admiration of every one, as being by far the grandest specimen of architecture.

I am, Sir,

Your obedt. servant,

T. O.

GENIUS IN OBSCURITY.

We consider that our pages are never better occupied, than in bringing to light the merit of individuals, whose genius entitles them to some degree of public attention, but who, from certain untoward circumstances, have been undeservedly suffered to dwell in obscurity. A case of this description happened, within these few days, to fall under our notice, and to withhold the mention of it from our readers, would, we conceive, be an act of injustice, both to them and to the person to whom it refers.

Nothing has tended more to excite the admiration of mankind, than the singular provision which nature has made to compensate the deficiency of one sense, by the superior acuteness of another. None, in general, are so distinguished for quickness of sight, as those who are strangers to the pleasure of sounds; while, on the other hand, few enjoy the sense of hearing and of feeling in such perfection, as those who are unacquainted with the charms of vision. Unless, when one avenue to the mind is entirely obstructed, another were susceptible of more than ordinary enlargement, the world would never have had the painful satisfaction of contemplating Saunderson as a professor of mathematics, Moyse as a lecturer on natural philosophy, and Metcalf as a projector and surveyor of roads.

To record the feats in art and

science, which have, in all ages, been achieved by the blind, would require the compass of volumes. But, in order to surprise our readers with narratives of this kind, we shall refer them neither to remote ages, nor to distant places. To accomplish this end, we are confident, we need only direct them to an individual of our own city.

The person to whom we allude, is one Mark Kidd, who resides in the Leopard-Close, High-Street, a little above the Cross. Mr. Kidd, who is at present about fifty years of age, is the son of a seaman, and a native of Greenock. He had the misfortune, when four years old, to lose his sight in consequence of the small-pox. Being thus disqualified for pursuing the hardy occupation of his father, he was bred to the profession of music. What his professional attainments are, we have had no means of ascertaining; but we have had abundant proof, that music is not the only profession for which nature seems to have designed him. At an early age, notwithstanding his want of sight, he displayed a strong predilection for mechanical pursuits. A piece of wood of any kind was always to him an acquisition of great value; and with no implement but his knife, he would cause it to assume a variety of forms. He delighted, however, to display his mechanical ingenuity in nothing so much as in the making of boats, a bias which may be easily accounted for, from the circumstance of his living in a seaport town, and of his father being a mariner.

This early attachment to mechanical pursuits has continued with him to the present day, and has afforded him the means of passing agreeably those hours of leisure, which otherwise might have been heavy and burdensome to him. When not engaged in swelling the mirth of some festive assembly, or in any thing connected with his profession, he generally fills up his vacant time by indulging his favourite propensity. Besides his knife, long the only instrument with which he wrought, he now uses the hand-plane and the saw; and he handles these simple implements of carpentry with a skill and dexterity, to which it is impossible to do justice.

We have witnessed but one effort of his genius in this department of human skill; but this is one of no ordinary character, being no less than a 74 gun ship, with four feet of keel, and measuring six feet from bow to stern. This miniature of the terror to British foes has cost Mr. Kidd the occasional labour of nearly seven years; but he has the satisfaction of having brought this monument of his skill, industry, and perseverance, near to a close. The under part of the ship, as well as the lower rigging, is entirely finished; and the upper rigging, with which he is at present engaged, he expects to have completed in the course of a few weeks. This ship is all regularly ribbed and built, the same as a vessel of the largest size, and, so far as we have been able to discover, deficient in nothing. The very decks are laid with planks, the same as any other ship; and the ports are formed with the utmost regularity. There are appended to her, one long boat and three smaller ones, the former regularly built, the latter scooped out of solid wood; and both are furnished with benches for rowers. The guns, from which she is to discharge her thunder, are made with the greatest accuracy, both as to length and thickness; and those for the higher decks are mounted on carriages. The only part of the workmanship which was not performed by Mr. Kidd, is the paint-

ing. The manner in which he has acquired such accurate notions of naval architecture, has, he says, been wholly by feeling.

It is unnecessary, we think, to be more particular with regard to this display of Mr. Kidd's genius, as we understand he will make every one who chooses, welcome to see it.

This is the fourth ship that Mr. Kidd has built, but the present, he considers as far superior to any of the others. One of those which he formerly made, stands, we are told, in the lobby of the present Lord Douglas; where the other two are, we have not heard.

We have been induced to be thus specific in our notice of Mr. Kidd, in consequence of his being man, and anxious to t fruit of his genius and ind some pecuniary advantage. gentleman desirous of gra lobby with an ornament curiosity, we would strongly mend Mr. Kidd's 74 gun no private individual can be to reward him handsomely labour, might it not be p by subscription, to be depo some museum?

For any person not trained to the art of ship-l to construct an accurate would be matter of no s prise; but for a blind ma complish this, is not only ast —it is almost miraculous.

Notice of some of the recent Magnetical Discoveries of Profes Hansteen and Oersted.

Having constructed an instrument for measuring the diurnal variations of the needle, he measured accurately the different oscillations which it makes during the day by the extent of the arcs in which it is made to vibrate; and, since the intensities of the magnetic forces are reciprocally, as the squares of the durations of equal numbers of oscillations, he assumes any one of these durations as unity, and expresses the others in parts of it. Thus, he assumed for unity the intensity corresponding to the duration of 813.6 seconds to 300 vibrations, taking this to be a minimum; because he found this intensity at an observation he made during the appearance of an Aurora Borealis. And here we may remark, that thunder-storms and eruptions of burning mountains have very surprising effects on the needle, in places in the immediate vicinity of these atmospherical and terrestrial convulsions. Thus, in Italy, De la Torré observed, during a great eruption of Vesuvius, that the variation was 16 deg. in the morning, 14 deg. at noon, and 10 deg. in the evening; and that it continued in that state till the lava grew so dark as no longer to be visible during the *night; after which*, it slowly increased to *13½ deg., where* it remained. Daniel Bernoulli found the needle chan tion 45 min. by an earthquake tity so small, that we are in think he must have been mistak if the earthquake had been v it is highly probable, that th would have been a great d Indeed, Professor Muller, at observed, that the declinatio needle in that place was very fected by the earthquake in Ca

From the numerous observat fessor Hansteen has made, he lated a table, which shows month a mean intensity corr to the stated hour of the day these observations, he conclude

1. The magnetic intensity h variation, the minimum of w between 10 and 11 in the fore the maximum between 4 and afternoon.

2. The monthly mean intens an annual variation, which h reduced to a table. From thi appears that, in the winter, perihelion, the intensity is co greater than what it is in the near the aphelion: a fact that render our hypothesis of the ex magnetism in the sun not alto

probable.* He also finds, that the greatest monthly variation is a maximum in the months of December and June, about the time when the sun is in the tropics, or perhaps more correctly, when the earth is in its perihelion or aphelion. It is a minimum near the equinoxes, or when the earth is at its mean distance from the sun. The greatest daily variation is least in the winter, and greatest in the summer. The greatest difference of the annual variation is 0.0359.

From a series of observations he made with an inclinatorium, he found that the inclination during the summer is about 15 min. greater than what it is in winter; and in the forenoon, about 4 or 5 min. greater than what it is in the afternoon; which agrees perfectly well with the former observation.

He next made an experiment during an Aurora Borealis, which he continued from noon till noon without interruption, that clearly proves the influence of this phenomenon in weakening the magnetic force; and, consequently, shows the relation between magnetism and electricity. There are many other experiments, however, that prove the connection between electricity and magnetism: one of the most remarkable being that of Professor Oersted, with a galvanic battery, or single plate of zinc and copper. To perform this experiment, nothing more is necessary than to procure a plate of zinc and a copper sheath for this plate, so made as to allow the zinc plate to be inserted in it without touching the copper. This being done, by pouring into the copper sheath a solution of nitric acid and water, and then making a communication between the copper and zinc, by means of a copper wire placed horizontally across the aperture in the sheath, the following effects will be produced: If a magnetic needle be placed near the wire, but under it, in whatever position it may have been before, it will now point its north pole, at right angles, to the horizontal wire; if the magnetic needle be now placed above the wire, the north pole will turn immediately and completely round, and the south pole will take the direction of a line, at right angles, also to the wire; and, if the form of the wire be varied, the phenomena will also be varied; but all of them in such a manner as to be at present incapable of explanation, but evidently showing the very intimate connection that exists between magnetism and galvanism, which is only another form under which electricity presents itself.

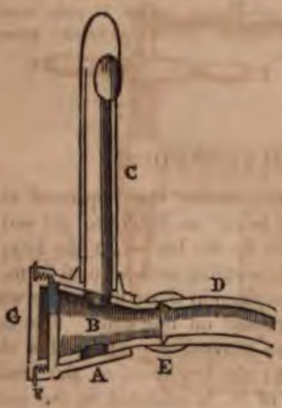
* See page 104.

MR. HART'S IMPROVED STOP-COCK.

Mr. Editor,—About four years ago, being much annoyed by the constant leakage of the stop-cocks on our water pipes, I began to think of some mode of remedying the evil, when an idea of one occurred to me, which would not be so liable to get out of repair. Accordingly, I made one on the following principle, which has been in constant use ever since, and which is as water-tight at present, as when first put in action.

This stop-cock differs from those in common use in this, that the pressure of the water takes place *upon the base of the conical key, and not upon the side,* as in stop-cocks made in the common form. By this means, the improved stop-cock is not so liable to get out of repair by the barrel, or the key, or both, wearing into an oval form, as takes place in those where the water is pressed on one side. The body is the moveable part in this stop-cock; the key fixed on the smaller end of it, is soldered to the water-pipe, and a swan-neck branch to the body of the cock. When the swan-neck is raised up, as in the annexed drawing, the cock is open, and the water escapes; when down, it is shut, and the water is prevented from escaping. As the key is made more conical than usual, to diminish the friction arising from the pressure of the water, it will not

stand in the open position unless there be a pressure of water in the pipe, the weight of the branch being sufficient to shut it. This constitutes the great improvement in this stop-cock; because, when the branch of the stop-cock is raised for the purpose of drawing water, and then left standing by the carelessness of servants or others, on finding none in the pipe, it falls down by its own weight, and prevents the overflow of water when it returns in the morning, as it cannot be raised except by the hand. By this means, a great waste of property is prevented, which always takes place when the old stop-cocks are left open, and when the water is withdrawn from the pipes during the night; a circumstance that has too often occurred in this city, to the great annoyance of the inhabitants. The following section of the stop-cock will make its construction plain.



A, the body, or barrel of the cock, with C, the swan-neck soldered to it; B, the key, forming, as it were, the termination of the water pipe D, by being soldered to it at E; the key is furnished with a port, or exit for the water, both above and below the letter B. If the swan-neck is required to move more than a quarter of a revolution, the lower one may be dispensed with, as its use is only to balance the pressure of the water on the key; G, a plug to shut up the end of the barrel after the key is in its place; the plug is rendered tight by being screwed up against a ring of leather, as shown at F.

I am, Sir,

Your obedient Servant,

Robt. Hart.

Glasgow, 13th March, 1824.

The public are certainly much indebted to Mr. Hart for this simple improvement. If adopted, as we think it will be universally, much damage to property will be prevented. Our own premises have been flooded with water from the pipes, at least a dozen of times within these three years, by the neglect of necessary precaution in our neighbours in the upper flats, to shut the stop-cocks at night, when they found upon trial that no water could be obtained.

PROBLEM.

Given the diameter D Q, of a circle, the segments A B, B D, of *the chord A D,* and the angles *S P, P S D;* required the position *of the point* S, the chords A P, P D, and the distances A S, S P, and S D. General solutions, by geometrical construction, trigonometrical calculation, and algebra, are requested.

SIR,—If the above problem meet your approbation, by inserting it in your valuable Magazine for solution, it will be very obliging to some of your readers. The problem is quite original; and, without involving much difficulty in its investigation, it may give some amusement to that class of your numerous readers whose taste leads them to cultivate their minds in the most convincing and useful of the sciences.—I am,

Your's respectfully,

A MECHANIC.

Glasgow, Feb. 2d, 1824.

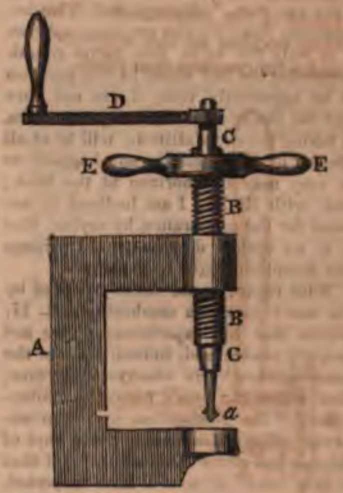
IMPROVED CRAMP DRILL.

To the Editor of the
GLASGOW MECHANICS' MAGAZINE.

SIR,—In No. VII. of your Magazine, page 99, I saw a description of a cramp-drill, which is certainly superior, in many respects, to the common brace and cramp, as the latter requires, in many cases, two persons to work with it, on account of the difficulty of fixing it; but the former having the screw and handle both attached to the cramp, there can be no necessity for more than one person to work with it.

In many cases, however, where there is little room to work, (such as betwixt the framing of machinery and the wall, betwixt card framing and the cylinders, &c.) it will be impossible to apply the cramp-drill (on account of the screw being in the way) where the cramp and brace may be quite easily applied.

It would, therefore, be a matter of considerable importance to have the properties of the one machine combined with that of the other, which may be done by making the *machine according to the following drawing.*



Description of the several Parts of the Drill.

A, the cramp,

B, B, the screw through which the spindle for holding the drill, turns.

C, C, the spindle.

D, the handle for turning it.
E, the handle of the screw.
a, the drill.

By inserting the above drawing and description in your Magazine, you will very much oblige, SIR,

Your humble Servant,

OPIFEX.

Johnston, Feb. 19th, 1824.

REMARKS ON QUERIES.

MR. EDITOR,—I was much gratified at seeing one of my questions taken up by a Paisley Correspondent, in No. IX. of the Magazine, and still more so when I observed that R. H. had given answers to all the three in No. X. I am much obliged to your Correspondents, although they both appear to regard me as a very inaccurate *Observer*.

It is said, by both of your Correspondents, that the fact stated in the straight-edge query, is mathematically false, and I admit that it *must* be so; but it remains yet to be shown, that it is not *apparently* true. I stated the question in common language, as, we say, "the sun rises," although that is mathematically false, for the sun does *not* rise, it is only the earth that turns round. Supposing the fact stated in this question to be apparently true, I am not sure that the observations made by mariners, in taking the sun's altitude, will be at all affected by it, unless the sun happens to be very near the horizon at the time; and, with R. H., I am inclined to account for the appearance, by saying, that it is an optical deception—but perhaps this deception might be explained.

With regard to the effect produced by the sun's rays, on combustion, R. H. admits that his experiments were not properly made; and, indeed, I am of the same opinion. He observes, however, that when the sun's rays were intercepted, "the combustion was then observed going on as well as if the rays of the sun had never reached it," and that is just what I would have expected, upon the supposition that the sun's rays had a tendency to prevent it from going on; but he goes on, to "conclude," that unless we find, by experiment, that a candle, or fire, is extinguished by the sun's rays, "we ought to doubt the fact altogether." Now, Mr. Editor, this is surely unreasonable. By the same reasoning, we ought to conclude, that unless the wind blows down the house, there is no wind at all. It is surely quite possible, that the sun's rays may have *some* effect upon a fire, without perhaps extinguishing it.

I would beg leave to add, that, for the truth of the facts stated in these queries, I depend entirely on the testimony of others, and not upon my own actual observation; and, although human testimony has often been lightly esteemed, and ridiculed, even by philosophers, it is nevertheless, not to be disregarded, if credible. Take, for instance, the subject of Meteoric stones. After the existence, and falling from the atmosphere, of these stones was sufficiently authenticated, from almost every quarter of the globe, philosophic men, because, forsooth, they could not explain the cause, took it upon them to doubt the fact altogether. The existence, however, and the falling of these stones, have now (in my opinion at least) been completely established, whether we can explain the causes of their formation or not. I do not imagine that these queries are of any great importance; and yet, perhaps, it might be of use to some people, that they could preserve their beer, milk, &c., in time of thunder, and it is not likely that a preservative will be found, until the cause is explained.

I am, Sir, your's, &c.

AN OBSERVER.

Tradeston, 8th March, 1824.

LETTERS AND QUERIES.

EXPERIMENT WITH WATER-*PROOF* VARNISH.

SIR,—I made the following experiment for the purpose of trying what effect the water-proof varnish would have in cementing leathern belts employed in driving machinery. I took two pieces of old leathern belts, and prepared a part at

the end of each, by smoothing it with a plane, for the purpose of joining them together; this part was eleven inches long by three inches broad. I then put upon this part a thick coating of the patent varnish, giving it full time to dry; then a second coating; and so on, until I had put on seven coatings; when the last coating was put on, and dried for a few hours, I then joined the two together, and laid it on a flat surface, with a weight above it, to hold the joint together, until sufficiently dry. When I removed the weight, I hung it up to dry for a few days. After it was sufficiently dry, I prepared it for trial, by making a loop on each end of the belt. The one end I fastened to the joist of a house, and on the lower end I suspended weights, until I had put on to the amount of 722 lb. English; the joint, at this time, had not yielded in the smallest degree. I then allowed the belt, with this weight to remain suspended, for the space of a whole week, and still there was no appearance of the separation of the pieces. I then put it to the test, by adding weights until they had reached the extraordinary amount of 850 lb. English; it remained suspended, in this state, for a few hours, and then broke down at the joint, leaving a part of the thin end of the other piece behind.

From this experiment it is obvious, that Mr. Mackintosh's patent varnish will be an excellent substitute for thongs, in cementing leathern belts. It is evident that there is no use for such a strain on any belt of the above size for the purpose of driving machinery.

I am, Sir,
Your's, respectfully,
A Mechanic.

Banks of the Leven, by Dumbarton, Feb. 21st, 1824.

STRAIGHT-EDGE QUERY.

Sir,—Supposing some of your Correspondents would give you an explanation of the straight-edge query of 'An Observer,' page 30; I thought it unnecessary to trouble you with my observations. I find, however, in your Ninth Number, that your Correspondent, S., denies the fact, although the reason was, manifestly, within his reach. This appearance, then, arises from refraction, which he considers too minute to take into his account. Any person, indeed, *conversant with astronomy* would have informed him, that the sun, and all the heavenly bodies, when near the horizon, appear several minutes higher than their proper place; and that, in consequence, the sun is seen before he reaches the horizon, in the morning, and after he is below it in the evening. This being a matter of fact, it follows, that the ray of light proceeding along the level straight-edge, must be deflected downwards, till it enter at, or near the visible horizon, when that is sea; as whether the observer is near to, or considerably above the sea, but little difference can arise. In the one case, if he has but a small field of view, refraction has not much space to act upon; and in the other, where a greater extent of horizon comes under his observation, of course, there must be a greater sum of refraction. Trusting this explanation will either be satisfactory, or produce one more so from some of your Correspondents,

I am, Sir,
Your's,
Mechanicus.

Leith, March 1st, 1824.

Permit me, while I have the pen in hand, to request some of your Glasgow Engineers, to inform me, through your work, what was the result of a late trial of Job Rider's Rotatory Steam-engine in your city, as I am informed, (with what truth I know not,) that, in the hands of one of your most ingenious mechanics, it has failed; though, lately, in several of the periodical scientific works, very flattering accounts are given of its value, as an *economical* application of steam-power.

Sir,—I take the liberty to call your attention again to the straight-edge query. The assertion in the query, that "a straight edge, placed on a level at any height on land, points immediately to the surface of the sea, if within sight of the sea," and that of your Paisley Correspondent, that a line drawn from any height on land, immediately to the surface of the sea, must deviate from the level, only so little as scarcely to be perceived by the eye—are, in my opinion, equally false. I could place the latter upon an elevation on land not at all comparable to that of Ben Nevis, where his line, drawn immediately to the surface of the sea, would form a very

rapid declivity; in my opinion, the following is the true state of nature on the subject:

A straight edge placed on a level, at any height upon land, will point, not immediately to the surface of the sea, but to that surface at a distance, and the distance will be found to bear an exact proportion to the height on which the straight edge is placed. Let some of your Correspondents be so good as state, for my information and that of the public, what that proportion is; and then I would propose, as a query, The elevation of Ben Nevis being 4350 feet, at what distance will a straight edge, placed level at that height, point to the surface of the sea? If you can spare a little attention to the above, you will farther gratify one of your constant readers,

A Working Man.

8th March, 1824.

ANSWER TO MR. BOAZ'S QUERY.

" Do not the hist'ries of all ages
Relate miraculous presages,
Of strange turns in the world's affairs,
Foreseen b' Astrologers, Soothsayers,
Chaldeans, learn'd Genethliacks,
And some that have writ Almanacks?"

Hudibras.

Mr. Editor,—Not being one of your Chronological Correspondents, my interference in this affair may be objected to, yet I cannot resist the desire of telling Mr. Boaz, that, in my eyes, his puzzle of last Saturday appears less worthy of notice than the former.

It is true, the "little varnished shilling manual" may not give the answer in this, as it did in the former case; but, every one versed in the history of calendars, knows that the month of September, 1752, contained only nineteen days, the first of which was Tuesday, and the last Saturday; consequently, it contained only two Sundays.

The months of August and October contained five Sundays each; therefore the consecutive months of August and September, or of September and October in the above year, answer the question so far; but when will a similar prodigy again occur? This, Mr. Editor, surpasses my skill; for though it may be possible to calculate when the errors of the present calendar will accumulate so as to render such elision again necessary, yet if our country be as tardy in making the alteration as formerly, twenty or thirty centuries more may elapse before we adopt it.

If Mr. Boaz says it can be answered with certainty, I am afraid he has some connection with those sapient successors of Lilly, who prognosticate every year, what weather we are to have the next. Many a new bonnet and ribands are, however, spoiled by the words "fair weather" standing where "very likely rain" should have been; but this, doubtless, is the fault of the printers.

S. L. C. A.

WONDERFUL INVENTIONS!!!

Dumfermline, 16th day of 2d month, 1824.

Respected Friend,—I cannot help being vain indeed, (if vanity may be allowed in any thing,) that in our dear Caledonia, such a hitherto able conducted *poor man's fireside* companion, as the Glasgow Mechanics' Magazine has started up, under the management of thee, and, I trust, a *host* of men of the first abilities, which will hand down our lucubrations to a late posterity, and make our names more immortal than those kings who are intombed in the Pyramids of Egypt. In thy notices to Correspondents, thou hast already complained of having too many curiosities of my kind, for which thou hast not room in thy pages; I, therefore, will endeavour to bridle my vanity for a season, until matters of much more importance be by thee exhibited to our view. In the meantime, I must tell thee what I am going to send: and, first, thou shalt have a drawing and description of my *Village time-piece;* this is the simplest of all chronometers, having only two wheels, a pendulum, and a pace; this simple machine not only tells the hours and minutes itself, but runs, *like water, or the gas light, from house to house in a long street, telling the hours and minutes correctly in every apartment, and all erected for the small sum of thirty shillings.* I am certain friend Owen will adopt this for his new establishment, as soon as he sees it in thy Magazine. The next is the *Chamber Flactorum;* this is a musical instrument, entirely new, having two German flutes, blown with bellows, which answer all the purposes of a chamber organ. The third is a *Sluggard Alarm;* this is a very simple machine, by means of which, a common *Silver Watch* is enabled to strip the sluggard perfectly naked, and to light a candle,

placed on a table, at the same instant. The fourth is the *Mouse Thread Mill*; this simple machine has exalted the common mouse from a plunderer and vagabond to a faithful and cheerful domestic labourer, and thereby enabled it to earn twenty times its own consumption. An account of this machine may be seen in almost all the newspapers of about the eighth month of last year.

All these, if thou or thy readers are solicitous to have, shall be by me illustrated, in the course, I think, of this year, that is, when thou hast room, and I have time.

I might mention another machine that I once had, but have not at present, *viz.* that by means of a *Cuckoo Clock*, when I was a weaver, (for fickle fortune has raised me to the condition of a small grocer, but how long her vibrating scales may keep me from the seat-tree, time alone must determine,) I caused it to throw a shovelfull of coals on the fire at 6 in the morning, set a pair of suction bellows a-blowing, and at half-past 6, set a tea-kettle a-boiling; it then pulled the clothes of my bed, when I arose to a bleezing fire and a boiling kettle, made my brose, and was at my loom by seven o'clock. I only used this machine for the two coldest months of the year.

D. H.

Query.—What is the reason that a screw-nail which cannot be drawn with a screw-driver 6 inches long, may be drawn easily with one 12 inches long?

X.

'A CONSTANT READER' wishes that some of our chemical Correspondents would furnish a recipe for making good red ink; as the most of what is to be got in shops becomes purple, or loses its colour altogether, which is a great blemish in a well-written book.

MISCELLANIES.

POISONS, AND THEIR CURE.

Corrosive Sublimate.—This substance, given in a dose of the eighth part of a grain, acts as a general stimulus on the alimentary canal and the secretions. Sometimes there is a sense of heat and pain in the stomach. If the dose is larger, or long continued, it produces colics and vomitings, with salivation and ulcerations of the mouth and tongue. This is followed by loss of the teeth, and affections of the bones in these parts; and, besides these effects, there occur cardialgia, dyspepsia, dysentery, dyspnœa, hæmoptysis, and violent pains in the bones and muscles, or in the joints, with trembling, palsy, tetanus, mania, and death. The quicksilver, in these cases, is sometimes deposited in a metallic form in many cavities. If given in an extreme dose, it produces death quickly; and, in this case, physicians are not agreed respecting the mode in which it operates on the functions.

This substance has been known to produce death also on several occasions when used externally, as an ointment to the entire skin, or as a plaster, or as a dressing for ulcers. The symptoms are nearly the same; salivation sometimes, or, without that, the usual affections of the stomach, and convulsions.

To discover if a patient has taken this poison, as it is always necessary, if possible, to ascertain the cause of the injury first, either the remains of the substance taken, or the matter vomited, if these cannot be procured, must be examined by the usual chemical tests. After death, the same investigation required for judicial purposes must be made of the contents of the stomach.

Treatment of the Patient.—The remarks to be made here on chemical antidotes to this poison, are of general application to all the mineral poisons. A substance, to be an antidote, should possess the following properties:

It ought to admit of being taken in large doses without danger.

It ought to act on the poison at the animal temperature, or at one inferior to that.

Its action ought to be speedy.

It should be capable of combining with, or decomposing the poison, in spite of the mucus or other secretions in which it may be entangled.

Lastly, it ought to deprive the poisonous substance of all its deleterious qualities.

Experiments made on animals have proved that the alkalies, the sulphuretted alkalies, and sulphuretted hydrogen, did not prevent the poisonous effects of this substance. Sugar, bark, and metallic mercury, have been recommended, but they produce no effect. Albumen decomposes corrosive sublimate, so as to produce an innoxious compound, and, when given in sufficient quantity, has succeeded as an antidote.

The practice, therefore, recommended is, to give large quantities of the white of egg mixed with water, as it may be given to any extent. If this cannot be obtained, linseed tea, rice water, sugar and water, broth, or even plain water, may be given. This practice also encourages vomiting, and must be continued till the symptoms abate. In case that vomiting cannot be excited, it is recommended to empty the stomach by means of an elastic bottle and tube passed into it. The more fluid of any kind that can be given, the better; and, in many cases, this has proved sufficient for the cure. They should be forced down, therefore, whether the patient is willing to drink or not.

Oily substances, often had recourse to, are useless, and may be injurious, by impeding the action of other substances. The remainder of the treatment must resemble that adopted in gastritis, or enteritis; local bleeding, fomentation, emollient injections, general blood-letting, the warm bath, and in general, the anti-phlogistic system.

Red Precipitate of Mercury. — This, whether procured by heat or nitric acid, is a violent poison, and produces nearly the same symptoms.

Turbith Mineral. — In practice, is scarcely known as a poison, but it is such. All the other active salts of mercury may be considered in the same light, and require no particular detail.—*Ed. Ency.*

WALKING HILLS.

It will be scarcely believed, that there are hills in France that are locomotive, and proceed every year a certain distance from the place they had stood in during the former; they are now near the village of Opoetere, a mile distance from Maastice. They are formed of fine sand, and are about fifty feet high; it may naturally be supposed, that such considerable masses of matter are slow in their movements, in proportion to their bulk, and the fact is, that they do not advance more than from ten to twelve feet yearly. The phenomenon was first observed about sixty years ago, and since that time they have passed over, in the direction from North to South, about twenty acres of land. Nothing can arrest the progress of these gigantic travellers; if they happen to meet trees in their way, they seize them and oblige them to bear them company. The country folk, as may be well supposed, do not much like the entry of such guests upon their lands, and therefore have endeavoured to check them by cutting a ditch across their path, and turning into it the water of a neighbouring stream; but the hills were not to be stopped so easily; they proceeded directly into the ditch, and as they dammed up the new current of the water, it was obliged to retire into its former channel. Since they have discovered the inefficacy of their means, they even let the unwelcome visitants pursue their journey in peace, and they now quietly travel in a Northern direction, leaving void one portion of land as they occupy another. The marvellous in this phenomenon, vanishes when it is known that the wind is the cause of it. The same thing takes place on the coast of Normandy, Brittany, Guienne, and Gascony; and, indeed, almost all places where there are sand hills. Such hills are a great injury to all lands upon which they settle, and if the proprietors neglect to arrest their progress, which is only to be done by skilful planting, their ruin in all probability ensues.

Here there is no middle way, either vigorous measures must be adopted to repress the evil, or patience collected to endure it. A community of benedictine monks, in a district where such hills were common, were, in the last century, in consequence of their neglect, compelled to quit the monastery, and take refuge elsewhere; for, the hills having passed through a stream, and over the walls of a church-yard, were beginning to press against those of the church itself, which they have actually since buried beneath them.

A similar accident happened during the life-time of Montague. Several dwelling-houses were buried beneath hills of this kind. "The inhabitants," says the philosopher of Perigord, "declare that the sea has made rapid progress against them, that they have

within a short time, lost two miles of ground. The same is heaped into hills that move, and make inroads on the land."

Not far from the town of St. Paul de Leon, in the department of the Coté du Nord, those sands have travelled a space of 63 miles since the middle of the 17th century, and they are now at no great distance from the town itself. "I have," says the author of 'A Journey into the Finisterre Department,' "seen from the high road leading to Le Never, an immense sand hill hanging over and menacing the inhabitants of St. Paul, for whose safety I entertain the greatest apprehensions."

Buffon likewise remarks, with respect to this district, that it seems to give credibility to what has been written, both by ancients and moderns, concerning the sand storms in the deserts of Africa, which are said to have swallowed up whole armies.

ON ABSORPTION.

A Correspondent, so far back as No. IV. made some inquiry respecting the principles of absorption, and as none of our Correspondents have as yet deigned to notice his communication, we have thought proper to insert the following extract, on this subject, from the *Edinburgh Encyclopadia*.

We learn from the researches of the anatomists, that lymphatics are very copiously distributed to all parts of the skin, and that they appear to terminate under the cuticle; we likewise know that various medical substances applied to the skin, particularly if we use the aid of friction, will enter the circulation, exhibiting the same action upon the system, as if they had been received into the stomach. In these cases, there is sufficient proof of the existence of cutaneous absorption, but it is a question that has given rise to much controversy, whether, when water is applied to the surface, as in the warm bath, or the aqueous vapour which exists in the atmosphere, it can be absorbed by the skin, simply in consequence of the body being immersed in it. A number of circumstances led us to believe in the reality of this absorption, particularly those that were brought forwards by Sanctorius, who was conceived to have proved, in the most decisive manner, that, under certain circumstances, the *weight of the body is sensibly* augmented by the water which it imbibes by the skin. Until very lately, the doctrine of cutaneous absorption was universally assented to, and many important pathological speculations were founded upon it, but the progress of modern discovery has thrown a doubt upon our former conclusions; and the opinion, perhaps, at present the most generally adopted is, that when the surface of the body is in its sound state, and where no external force is employed, the skin is impervious to moisture, but, that various substances may be forced into it by friction, and even by long immersion in warm water, by which the epidermis becomes softened, and, perhaps, partially destroyed, at the same time that the mouths of the lymphatics are relaxed and rendered more disposed to receive what is presented to them.

SCARLET FEVER.

It has been customary to fumigate the rooms of those infected with the scarlet fever, after they have recovered; and we can recommend to our readers the following fumigation, which may be used even during the attack:—Take of common salt (which has been dried in a shovel over the fire) two ounces; saltpetre (nitrate of potass) two ounces; oil of vitriol (sulphuric acid) two ounces, by measure. Mix the salts together in a china basin; then pour over them the oil of vitriol, and place the basin in a corner of the sick room. A white and somewhat suffocating smoke rises from the mixture, which is the nitro-muriatic acid. It is produced by the oil of vitriol decomposing the common salt and the saltpetre, and extricating their acids, which unite and fly off in the state of a visible gas. This compound acid is supposed to neutralize the infectious matter generated by the disease, and, consequently, to destroy, or at least weaken its power. *Lit. Gaz.*

GLASGOW OBSERVATORY.

We congratulate our fellow-citizens, that this useful Institution has been again purchased for the use of the public. We sincerely wish that it may not be allowed to sink, a third time, into that obscurity and inutility which have too long been its reproach. Indeed, from the patriotic individuals now connected with it, we think there is every reason

to expect that it will soon become one of the most flourishing institutions in Glasgow. The gentleman in whose name, we understand, the purchase was made, is a sufficient guarantee that it will be established on a more liberal foundation than ever it has been formerly. We would, however, offer a word of advice on the subject, as we have its success much at heart.

Let the Institution be put into the hands of a single individual, an enthusiast in the science of astronomy, and one desirous of communicating his knowledge. Let him be unshackled by committees, and subscribers, and preferences, and admissibles, and non-admissibles. Let him take his own way, in so far as appears evidently for the good of the Institution. Let him admit the public, indiscriminately, for a small sum; and let him adopt any improvement, by new exhibitions, or by lectures and illustrations; and we shall vouch for the prosperity of the Institution, and the ultimate advantage of the individuals who have come so nobly forward on the present occasion.

ANDERSON'S INSTITUTION.

We understand that about forty pounds worth of valuable scientific books will, this season, be added to the extensive library belonging to the Mechanics' branch of Anderson's Institution. These books are purchased with the proceeds of 1s. on each ticket sold during this session. The Managers have also recently added a number of new and ingenious models to the apparatus of the Institution; and an additional number of models are preparing, which will be finished before the conclusion of the session.

DISCHARGING OF TURKEY-RED.

As our Correspondents on the BANDANA CONTROVERSY seem bent on a pitched battle, and as our limits will not, by any means, admit of an ample *ring* for the combatants, we have, out of consideration for our readers, changed the field of contest from the pages of our work, to separate statements by the parties themselves, which will accompany the Magazine. In dismissing this subject, we think proper to state, that, on one point, we are perfectly satisfied; namely, that, in the month of November, 1802, Mr. Miller, ignorant of the nature of any previous attempts that had been made towards the same object, did invent a discharging process by means of presses, which, however our Correspondents may choose to slight it, was generally adopted as soon as it was known. From all the inquiries we made at the most accurate sources of information to which we had access, we never could learn, nor are we yet satisfied, that any similar process had been accomplished, which was fit for making this branch of manufacture a business. If, however, this was accomplished, we shall be happy in being the means of bringing to light, the merit of *all* who have had a share in this important invention. With respect to Mr. Campbell's statement, which accompanies this Number, we would be understood as suspending our judgment, till we see whether it be followed by any counter-statements. Some of our readers, who think light of the determination of such questions, it may be proper to remind, that the desire of fame is the most powerful which actuates men; that the blood of millions has been sacrificed for its gratification, and that, if not indulged in the far nobler and the peaceful pursuits of adding to the comforts of mankind, a great, an insuperable barrier would be raised to the improvement of the race.

NOTICES TO CORRESPONDENTS.

The communications from Thos. Johnstone, Wm. Cooper, H. G., W. K., L. E., R. G., &c. and the Description of the Portable Copying Machine, will be inserted.—' A Friend to Science' will find all his ideas superseded, in Wallace's Essay on Weights and Measures.—P.'s query is not stated with sufficient clearness.—A. has merely stated additional facts, without explaining their reason; now, one fact is as good as another of the same kind for that purpose; let him explain the cause, and we shall be glad to insert his communication.—M. S.'s letter is not legible in some parts, and contains irrelevant matter in others; we wish he would state his observations on Steam more distinctly, and favour us with his address, as the error he points out in the work he criticises, is of great importance.—W. B., Edinburgh, and N. L., are too late.—W. G.'s answer to K.'s query was wrong in the formula, though right in the answer; he is wrong respecting the generality of his solution to A.'s query; his answer to Mr. Boaz's query, though quite correct, is superseded by that of S. C. L. A.; his answer to the Mechanical query, will be inserted in our next.—A ' Looker-on,' and J. D., Edinburgh, have surely forgotten us. ' A Learner's' communication was printed according to his own orthography; we are satisfied with S. B.'s attention.—J. W. under consideration.—J. P. is too keen; we have not yet determined in the negative.

In page 153, article ' Blasting Rocks,' col. 1, line 13, in some copies, *for* 9-4ths *read* 4-9ths.
In page 154, article ' Solders,' col. 1, line 16, *for* tin-plate *read* tea-plate; and, col. 2, line 3, *for* spiler *read* spelter.
In page 160, col. 2, line 11, *for* 5 *read* 4.

☞ Contributions received by the Publisher; also, by Messrs. E. West & Co. Edinburgh; and Mr. J. Lawrence, Paisley.

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J. CURLL, PRINTER.

THE GLASGOW
MECHANICS' MAGAZINE.

" Barbarity is polished, infant arts
Bloom in the desert, and benignant peace
With hospitality begins to soothe
Unsocial rapine and the thirst for blood."—*Glover.*

No. XII. *Saturday, 20th March,* 1824. Price 3*d.*

MACHINE FOR MAKING SCREW TOOLS.

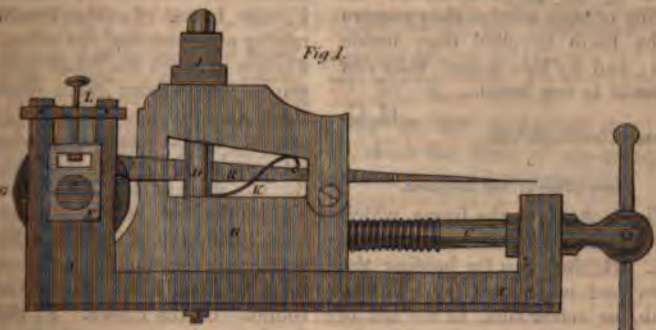
Fig. 1.


Fig. 2.


Fig. 3.


Fig. 4.


Fig. 5.

MACHINE FOR MAKING SCREW TOOLS.

Mr. Editor,—This machine was invented for the purpose of making screw tools, or, as they are more generally termed, combs. The invention is not mine, but I made one improvement upon it a few years ago, and another very lately. The brasses in which the arbor runs, are made to go up and down by means of a screw. In cutting outside combs, they require to be more bevelled than inside ones; and by this screw, they can be made to any bevel.

H. G.

Glasgow, 5th March, 1824.

Description of the Machine.

Fig. 1. A, A, is the frame, which may be made of malleable, or cast iron. B, the grips for holding the screw tool when cutting. H, the comb, or screw tool, in the act of being cut. D, a stud, with the nut I, fixed in the under jaw of the grips for holding the comb. There are two of these studs, D, one in each side of the grips, being $2\frac{3}{4}$ inches in breadth, and having a joint on each side, for the purpose of allowing the comb to go through the centre. K, a spring for raising up the top jaw. C, a screw for pushing forward the grips to the cutter, G, which is fixed on an arbor. E, the end of the arbor. F, the brass. L, the screw for raising and lowering the arbor. J, a screw through the frame into the grips, for keeping them down to their place; this screw slides into a slit, S, (fig. 2.) which is a horizontal view of the frame, T. M, (fig. 3.) is a view of the cutter with a slit in the one side, to prevent it from turning on the arbor, which is feathered. N, (fig. 4.) is the arbor, with a handle on it, to turn it round. O, the cutter. P, the nut for fixing the cutter. R, is an inside comb, in the position it is when cutting.

ILLUSTRATION OF THE PARALLELOGRAM OF FORCES.

Solution of the Question proposed in No. X. p. 158.

By Construction.

Describe the circle N E W S, figure 5, and draw two diameters, N S, and E W, at right angles to each other, representing the meridian and the parallel of latitude, and let C be the place of the vessel. Draw the line C D = 6, from a scale of equal parts, making, with the meridian N S, an angle of 35°, and representing the direction and magnitude of the force of the wind per hour. Draw the line C B = 3, from the same scale, making, with the meridian, an angle of 15°, and representing the direction and magnitude of the force of the current per hour. Complete the parallelogram D C B A, and join C A. The diagonal C A will represent, in direction and magnitude, the result of the joint action of the wind and current, or the course and velocity of the vessel per hour, when acted upon by both at the same time; and the angle N C A, which the diagonal makes with the meridian, will be its course. Now, if the angle N C A be measured upon the circle, and A C, upon the same scale of equal parts, the course will be found = N. 64° 26′ W. and the velocity = 4.675 miles per hour.

By Calculation.

In the triangle A D C, given the side C D = 6, and the side A D =

B C = 3. Now the angle B C D = 180° —(N C D + S C B) = 180° — 50° = 130°. But D A C + D C A = B C D, because D A C = A C B, (Euc. 1. 29.) Therefore, D A C + D C A = 130°, and consequently A D C = 50°. Now, the sum of the sides of any triangle is to their difference, as the tangent of half the sum of the angles opposite them, is to the tangent of half their difference. Therefore, by logarithms,

As, C D + D A = 9, = ———— 0.954243
To, C D — D A = 3, = ———— 0.477121
So is, Tan. ½ (D A C + D C A) = 65° = ———— 10.331328

To, Tan. ½ (D A C — D C A) = 35° 33′ 30″ = 9.854206

Hence, 65° + 35° 33′ 30″ = 100° 33′ 30″ = D A C.
And, 65° — 35° 33′ 30″ = 29° 26′ 30″ = D C A.

Also, N C D + D C A = 35° + 29° 26′ 30″ = 64° 26′ 30″, = N C A, the course. Now, to find A C, since the sines of any triangle are proportional to their opposite sides, we have, by logarithms,

As, sin. D C A = 29° 26′ 30″ = ———— 9.691555
To, sin. A D C = 50° = ———— 9.884254
So is, A D = 3 = ———— 0.477121

To, A C = 4.6754 = ———— 0.669820

Whence the rate of the velocity of the vessel, per hour, is 4.6754 miles, and her course is N. 64° 26′ 30″ W. or N. W. by W. ¼ W. nearly.

By the Traverse Table.

Course.	*Distance.*	*Latitude.*		*Departure.*	
		N.	S.	E.	W.
N. 35° W.	6	4.91			3.44
S. 15° W.	3		2.90		0.78
		4.91	2.90		4.22
		2.90			
N. W. by W. ¼ W.	4.7	2.01			4.22

By taking the nearest numbers that can be found in the Table, the velocity is 4.7 miles per hour, and the course 5⅝ points.

We received the above elegant solution from three Correspondents, W. G., W. K., and J. D. C. This solution, however, proceeds on the supposition that the resistance of the water, to the motion of the vessel, is the same, whether her velocity be six miles or three miles *per hour. Now, it is obvious, that* if the velocity be increased, the resistance will also be increased; hence the vessel will not describe the exact diagonal of the parallelogram, but a curve, the nature of which we wish some of our more learned Correspondents would discover; and likewise whether the vessel would be found ultimately at

the extremity of the diagonal, supposing that she did describe a curve in her course.

As some of our Correspondents seem very fond of such questions, we shall here propose another of the same kind:

A boat in a current which would move her at the rate of six miles an hour in a S. S. E. direction, is to be carried 30 miles due East, by persons who can row her at the rate of eight miles an hour; in what direction must they row, and in what time will the boat complete her voyage?

ON CALORIC, AND ITS MEASURE.

WHENEVER we begin to turn our attention to physical and chemical phenomena, we observe that the most powerful agent, the most active, and that which is most generally employed in nature and in the arts, is fire. We feel every moment the effects which it produces upon our organs, either when it scorches them with too great intensity, or when it gently warms them during the rigours of winter. It inflames all substances; and if it does not burn them, it melts them, renders them liquid, makes them red, causes them to boil, and converts them into vapours. Even when it seems to act with less force, it extends the dimensions of bodies, it changes their volume, and incessantly modifies them in their most hidden properties. To be able to observe these properties in such a manner as to render them comparable in different bodies, or in the same bodies at different times, we must be provided against this perpetual cause of variation; and since we cannot prevent it from acting, we must at least find out some mode of fixing the exact state in which it has put every body at the moment of observation.

Let us first, however, reduce this cause to its most abstract expression. Although the word fire carries along with it the idea of flame and of light, yet it is obvious that all the phenomena which we proceed to describe, might be produced without the concurrence of these two circumstances; for when lead is melted in an iron vessel by means of fire, although it neither burns, nor emits light, yet it becomes capable of heating other bodies in its turn; it will melt ice, sulphur, and pewter; it will inflame wax; it will boil water and other liquids, and convert them into vapour. Since it thus acts upon bodies without flame or light, we can, in imagination, separate these two modifications from the principle, whatever it may be, which produces all these effects; and to fix invariably this separation, to denote solely this principle, we give it a particular name, we denominate it *caloric*.

This simple and natural distinction leads us to observe, that the word *heat*, in which is commonly included the vague idea of a cause, expresses only the sensation which caloric produces on our organs; and by extension, that which it produces on organs of greater resistance, or even upon inorganized bodies. The word heat, therefore, ought always to be employed in this single acceptation, to express generally the particular mode of action in caloric.

But experiment proves, that the sensation of heat has not always the same force; there is a considerable difference between the mild heat which we experience in a warm bath, and that which burns us when we touch a bar of red-hot iron. The heat which exists in a single live coal is sufficient to inflame sulphur;

but it is not sufficient to melt copper or silver. In short, to define the different actions of caloric in these different circumstances, we employ the name of *temperatures;* and those temperatures are denominated more or less warm, which produce, or are capable of producing, upon us or upon other bodies, sensations of heat more or less vivid. By this we mean only to express the inequality of these sensations and of their effects, but not to measure or fix it; and still less do we pretend to draw from it any induction respecting the manner in which they depend on the caloric which produced them. All these can only be determined by exact means, which shall be immediately explained.

It often happens in the sciences, that those who introduce a new term to express the unknown cause of a phenomenon, allow themselves afterwards to be led away so much as to wrest the definition from its abstract sense, to realize it, and to give it a form; this has occurred, at least, in the case of caloric. The most of natural philosophers and chemists consider caloric as a kind of matter to which they attribute many properties analogous to those which other material substances possess, such as elasticity, compressibility, and the power of entering into combination with other bodies. It is supposed to possess these material properties from analogy; for as they can neither see caloric, nor weigh it, they are obliged, if they regard it wholly as matter, to consider it, at least to the senses, as destitute of the most apparent properties of matter, and those by which we can assure ourselves of the material existence of bodies; namely, impenetrability and gravity. Other natural philosophers, have considered caloric not as matter, but as a principle of motion, which excites in the particles of bodies certain minute vibrations, whence the sensation and the phenomena of heat are derived. A few physico-geometers, attached neither to the one nor the other of these opinions, confine themselves to the admission of principles common to both. Thus are we stopt all at once, when we would remount to the primary causes of phenomena; the end of our knowledge is to remove doubt, and to apply it only to those objects which our reason cannot, or has not yet attained. The art of experimenting consists in discovering the phenomena of those laws which are the most general and the most powerful. Such facts, well established and exactly recognized, serve then as principles to arrive at other facts as consequences of the former. Thus our uncertainty applies no longer to the general phenomena, nor to their combination, which alone are really useful to us; they apply uniformly to a small number of facts; and if they are inevitable, they are at least reduced to their just limits. We perceive other phenomena succeeding them, like the generations of men, in an order which we cannot but observe, but which we can neither explain nor conceive how it commenced. We follow the links of an interminable chain; we are well able, if we do not leave it, to remount from one link to another; but the point where the chain is suspended is not within the reach of our feeble hands.

To discover and to fix the natural connection of phenomena with one another, it is not sufficient to make vague observations, and to involve them in hypotheses always vaccilating and uncertain; we must determine exactly the nature and extent of their effects, that we may unite in our demonstrations only what are rigorously given; in a word, we must measure them. To measure and to weigh, are the two great

secrets of chemistry and natural philosophy; they are the causes of all the discoveries that have been made in modern times.

But to fix, by precise measures, the different degrees of the action of caloric, shall we employ the devouring and destructive effects which it exercises upon almost all bodies in nature? Assuredly not; since the very alteration which results from it, in the constitution of bodies, excludes every idea of comparison. Shall we discover more fixed limits in the variable sensations of heat and cold which we experience? By no means. It requires little reflection upon the nature of our sensations, to perceive that the indications which they give us are purely relative. The light, which is sufficient to enable us to discern the objects in an exhibition-room where we have remained for some time, seems to us quite obscure, when our eyes come to behold the brilliant light of day. The very time of thaw, which appears to us to be uncommonly mild, when it happens all at once in the midst of the rigors of winter, would seem insupportably cold if we suddenly experienced it in the midst of the great heats of summer. It is for this reason that the temperature of vaults under ground appear cold to us in summer, and warm in winter; although, in reality, they remain constantly the same, as we shall afterwards prove. It is obvious, then, from these examples, that the different degrees of the intensity of our sensations cannot furnish us with a constant measure of the causes which produce them, since the idea which they give us is only relative and dependant on circumstances.

We are thus led to search among the phenomena of which caloric is the cause, for those which, acting upon non-organic substances, instantaneously modify them in a recognizable manner, without in the least altering their nature or their internal constitution; so that the cause being removed, the bodies resuming exactly their first state, whatever be the number of transient variations to which they have been exposed. And there does exist a phenomenon, of which caloric is the principal cause, and which completely fulfils all these conditions; it is that which is called the dilatation and the contraction of bodies.

It is a general and easily demonstrated fact, that all bodies which we render hot, without changing their constitution, extend in all their dimensions in such a manner as to occupy a volume or space more considerable than that which they occupied at first. This modification of bodies is called *dilatation;* and when a body undergoes this change, we say that it *dilates*, or *expands*. All bodies, whatever be their nature, are susceptible of the effect of this experiment.

(To be Continued.)

EXPERIMENTS IN GALVANISM.

Mr. Editor,—Some time ago, I constructed a galvanic pile with 46 circular plates of zinc of the size and thickness of a penny, 46 pence, and the same number of pieces of wet cloth, the electric effects of which were very sensibly felt in the fingers and hands, on touching the upper and lower ends of the pile at the same time.

Finding it troublesome, when I wished to make any experiment with it, to take down and replace all the plates, and imagining, that by arranging them in a trough, I would not only put them more easily into

a state of action, but, at the same time, increase considerably their power. I constructed two troughs of wood, of the width and depth of the plates; divided each of them by thin wooden partitions into 23 cells of sufficient length to contain a pair of plates, and allow a space of ½ of an inch for water between them; and gave both, in the inside, a thin coat of common turpentine varnish.

I then placed a zinc plate on one side, and a penny on the other side of every partition; (observing to place the zinc plates on the same side of the partitions throughout the whole range;) I connected every zinc and copper plate together by an arc of copper wire passing over the top of the partitions between them; and placing the ends of the troughs together, so as to appear one, I formed a communication between the adjacent cells with a piece of copper wire.

To try the effects of this instrument, the cells were all filled with water, and I applied a finger to each of the extreme cells at the same time, but, to my disappointment, felt no commotion. On examining the troughs, I discovered that in several parts of them the water in adjoining cells had formed a connection under the partitions, and concluded that this was the cause of the absence of electric phenomena.

To remedy this defect, I varnished each cell with common green varnish, so as to make it completely water-tight; but, on repeating the experiment, I was equally unfortunate, and have hitherto been unable to discover the reasons. The opinions of any of your learned Correspondents respecting the causes of the inactivity of the instrument I have described, if given in your Magazine, will much oblige,

A STUDENT OF NATURAL PHILOSOPHY.

Banks of the Annan, 21st Feb. 1824.

CHEMICAL EXPERIMENTS.

To make Phosphorus.

THIS substance is commonly of a light amber, and semi-transparent colour, though, when it is prepared, it is nearly transparent and colourless. It is easiest made in the following way: Calcine a quantity of bones, that is, burn them till they emit neither smoke nor smell, and then reduce them to a fine powder. Dilute a quantity of this powder in a stoneware, or china vessel, with four times its weight of water; and mix in this solution, by degrees, a quantity of sulphuric acid, a sixth part less than the quantity of powder, taking care to stir the mixture after every addition of the sulphuric acid. The mixture will soon become hot, and produce a great quantity of air bubbles. Allow it to remain in this state for twenty-four hours, stirring it frequently with a glass, stone, or china rod, to cause the acid to act upon the powder.

When this process has been completed, pour the whole on a filter of cloth, receiving the liquid which runs through in another vessel of the same kind; pour a quantity of pure water repeatedly on the white powder which still remains on the filter, allowing it to pass also into the new vessel, and then throw away the powder as useless. Dissolve now a quantity of nitrate of lead in water, and pour it slowly into the acid liquid which remains; a white powder will be observed falling to the bottom of the vessel during this

process, which must be continued as long as the powder continues to fall. When it ceases, filter again. The white powder which remains on the filter the second time, must now be well washed and dried; mix with this powder, one sixth of its weight of charcoal powder, and put the mixture into an earthenware retort. Put this retort into a furnace, and immerse its beak in a vessel of water, so as to be merely below the surface. Heat the retort gradually till it becomes white, when a great quantity of air-bubbles will issue from the beak, and take fire when they reach the surface of the water. At last, a substance drops out, resembling melted wax, and congeals under the water; this substance is the phosphorus. When it is newly made, it is always impure, being mixed with charcoal dust, and other matter. It may be deprived of these impurities by melting it under water, and then squeezing through a pie[ce of] shamois leather. It is f[ormed into] sticks by putting it into [a fun]nel with a long tube, sto[pping the] bottom with a cork, and [immersing] it in warm water. The [phosphorus] then melts and takes t[he form of] the tube. When cold, [it is] pushed out with a stic[k. When] kept some time in water, [it acquires] an opaque coating, and [it very] much resembles white w[ax; it has] nearly the same consis[tence, and] may be cut with a knife [or broken] to pieces. It is insolubl[e in water.] If air be excluded, it ev[aporates at] 219°, and boils at 554°. [Its speci]fic gravity is 1.77 nearly. [It melts] at about 100°. Care mu[st be taken] to keep it under water, [it is so] combustible that it cann[ot be] melted in the open air w[ithout tak]ing fire, and it must b[e observed] that it is poisonous.

(To be Continu[ed.])

THE CHRISTIAN PHILOSOPHER; or, the Connection of [Science and Philosophy with] Religion. With an Appendix, containing Notes and Illustr[ations. By] THOMAS DICK, Perth. 12mo. pp. 443. Longman & Co. 182[3.]

THE volume before us is one which we hail with peculiar pleasure, and would earnestly recommend to the perusal of all who entertain any doubts as to the consistency of nature and revelation, as well as the perfect harmony of christianity with modern science. It is written in a free and unaffected style, displaying much acuteness, and a singular felicity of expression.

The observance of human nature is an inexhaustible subject to a reflective mind; and where that observance is combined, as it is in this work, with both scientific and metaphysical research, the work must be in every way interesting.

After a very suitable introduction, Mr. Dick's plan is branched out into the following chapters:

I. Of the Natural [Attributes of God,] Power, and Wisdom o[f God, as] illustrated in the Magn[itude and] Motion of the Heavenl[y Bodies;] the Machinery and V[...] Nature, with the Me[chanism of] Animated Beings: also, [the Good]ness of God to Man, [and the] Inferior Animals.

II. A Cursory Revie[w] of the Sciences which ar[e related to] Religion and Christian [...] namely, Natural Hist[ory, Geo]graphy, Geology, Astro[nomy, Na]tural Philosophy, Chem[istry, Ana]tomy, Physiology, and [...]

III. The relation whi[ch the In]ventions of Art bear to [the Objects] of Religion; as Printin[g, Naviga]tion, the Telescope, t[he Micros]cope, Steam Navigation,

IV. Scriptural Facts illustrated from the System of Nature.

V. Beneficial effects which would result from connecting Science with Religion.

We subjoin, from the Third Chapter of this work, the author's account of the invention of the Telescope, and the discoveries made by it; together with a notice extracted from the Appendix, of a new Reflecting Telescope, constructed by himself.

"We might be apt to think, on a slight view of the matter, that there can be no immediate relation between the grinding and polishing of an optic glass, and fitting two or more of them in a tube, and—the enlargement of our views of the operations of the Eternal Mind. Yet the connection between these two objects, and the dependence of the latter upon the former, can be fairly demonstrated.—A spectacle maker's boy, happening to amuse himself in his father's shop, by holding two glasses between his finger and his thumb, and varying their distance, perceived the weathercock of the church spire opposite him, much larger than ordinary, and apparently much nearer, and turned upside down. This new wonder excited the amazement of the father; he adjusted the two glasses on a board, rendering them moveable at pleasure; and thus formed the first rude imitation of a perspective glass, by which distant objects are brought near to view. Galileo, a philosopher of Tuscany, hearing of the invention, set his mind to work, in order to bring it to perfection. He fixed his glasses at the end of long organ pipes, and constructed a telescope, which he soon directed to different parts of the surrounding heavens. He discovered four moons revolving round the planet Jupiter—spots on the surface of the Sun, and the rotation of that globe around its axis—mountains and valleys in the Moon—and scores of fixed stars, where scarcely one was visible to the naked eye. These discoveries were made about the year 1610, a short time after the first invention of the telescope. Since that period, this instrument has passed through various degrees of improvement, and by means of it, celestial wonders have been explored in the distant spaces of the universe, which, in former times, were altogether concealed from mortal view. By the help of telescopes, combined with the art of measuring the distances and magnitudes of the heavenly bodies, our views of the grandeur of the Almighty, of the plenitude of his power, and of the *extent* of his universal empire, are extended far beyond what could have been conceived in former ages. Our prospects of the range of the divine operations are no longer confined within the limits of the world we inhabit;—we can now plainly perceive that the kingdom of God is not only "an everlasting dominion," but that it extends through the unlimited regions of space, comprehending within its vast circumference thousands of suns, and ten thousands of worlds, all ranged in majestic order, at immense distances from each other, and all supported and governed "by Him who rides on the heaven of heavens," whose greatness is unsearchable, and whose understanding is infinite.—The telescope has also demonstrated to us the *literal truth* of those scriptural declarations which assert that the stars are "innumerable." Before the invention of this instrument, not more than about a thousand stars could be perceived by the unassisted eye in the clearest night. But this invention has unfolded to view not only thousands, but hundreds of thousands and millions of those bright luminaries, which lie dispersed in every direction throughout the boundless dimensions of space. And, the higher the magnifying powers of the telescope [are,] the more numerous those celestial orbs appear; leaving us no room to doubt, that countless myriads more lie hid in the distant regions of creation, far beyond the reach of the finest glasses that can be constructed by human skill, and which are only known to Him "who counts the number of the stars, and calls them by their names."

"In short, the telescope may be considered as serving the purpose of a vehicle for conveying us to the distant regions of space. We would consider it as a wonderful achievement, could we transport ourselves two hundred thousand miles from the earth, in the direction of the moon, in order to take a nearer view of that celestial orb. But this instrument enables us to take a much nearer inspection of that planet, than if we had actually surmounted the force of gravitation, traversed the voids of space, and left the earth 230,000 miles behind us.

For, supposing such a journey to have been accomplished, we would still have been ten thousand miles distant from that orb. But a telescope which magnifies objects 240 times, can carry our views within ONE thousand miles of the moon; and a telescope, such as Dr. Herschel's 40 feet reflector, which magnifies 6000 times, would enable us to view the mountains and vales of the moon, as if we were transported to a point within 50 miles of her surface. We can view the magnificent system of the planet Saturn, by means of this instrument, as distinctly as if we had performed a journey eight hundred millions of miles in the direction of that globe, which, at the rate of 50 miles an hour, would require a period of more than eighteen hundred years to accomplish. By the telescope, we can contemplate the regions of the fixed stars, their arrangement into systems, and their immense numbers, with the same distinctness and amplitude of view, as if we had actually taken a flight of ten hundred thousand millions of miles, into those unexplored and unexplorable regions, which could not be accomplished in several millions of years, though our motion were as rapid as a ball projected from a loaded cannon. We would justly consider it as a noble endowment for enabling us to take an extensive survey of the works of God, if we had the faculty of transporting ourselves to such immense distances from the sphere we now occupy; but, by means of the telescopic tube, we may take nearly the same ample views of the dominions of the Creator, without stirring a foot from the limits of our terrestrial abode. This instrument may, therefore, be considered as a providential gift bestowed upon mankind, to serve, in the mean time, as a *temporary substitute* for those powers of rapid flight with which the seraphim are endowed, and for those superior faculties of motion with which man himself may be invested, when he arrives at the summit of moral perfection."

New Telescope.

"About a year ago, the Author commenced a series of experiments on Reflecting Telescopes; and [he] has lately constructed several on a new plan and principle. In this construction, there is no *small* speculum, either plane, convex, or concave; there is no tube, except a short one of two or three inches in length, for holding the speculum. The observer sits with his back to the object, and views the image formed by the speculum through an eye-piece, which requires to be nicely directed and adjusted. Three or four instruments of this construction have been fitted up, with specula of 5, 8, 16, and 28 inches focal distance. One of them having a speculum of eight inches focus, and two inches diameter, with a terrestrial eye-piece, magnifying about 25 times, forms an excellent parlour telescope, for viewing land objects, and exhibits them in a brilliant and novel aspect. When compared with a Gregorian of the same size and magnifying power, the quantity of light upon the object appears nearly doubled, and the image *is equally distinct*. It represents objects in their natural colours, without that dingy and yellowish tinge which appears when looking through a Gregorian. Another of these instruments, having a speculum of 28 inches focal distance, and an eye-piece producing a magnifying power of about 100 times, serves as an excellent astronomical telescope. By this instrument, the belts and satellites of Jupiter, the ring of Saturn, and the mountains and cavities of the moon, may be contemplated with great ease and distinctness. By placing the pedestal on the floor of the apartment, when the object is at a high elevation, we can view celestial phenomena with the same ease as if we were sitting at a writing desk reading a book. With a magnifying power of about 50 or 60 times, applied to this telescope, terrestrial objects appear extremely bright and well defined. A speculum of 37 inches focal distance, and 6 inches diameter, is just now fitting up on the same principle. The specula used in these instruments are far from being good; being of a yellowish colour, and having large holes in the centre; as they were originally intended for Gregorian Reflectors; yet the brightness of vision approaches nearly to that of Achromatic Telescopes. The experiments which have been made on this subject, demonstrate that a *tube* is not necessary for a Reflecting Telescope, when viewing either celestial or terrestrial objects; and, therefore, this construction of the instrument may be denominated THE AERIAL REFLECTOR. A more detailed account of this telescope will probably soon appear in some of the Scientific Journals."

LETTERS AND QUERIES.

MR. M'FADYEN.

MR. EDITOR,—I beg you will indulge me with one remark on the observations of 'An Observer,' in No. VIII., and your own comments in the 10th Number of your Magazine, relative to the introductory lecture of Mr. M'Fadyen. I do not intend to enter into the discussion of subjects which have engaged the attention of the most eminent geologists, and which, notwithstanding, are still involved in obscurity. I wish merely to vindicate a most amiable and highly gifted townsman from even the suspicion of having publicly expressed opinions repugnant to the principles of our holy religion, and as countenancing doctrines alike unscriptural and unphilosophical. Such a charge against a public teacher, is of a very grave nature, and, in the present instance, cannot be too promptly met. The detached passages given by some one who has taken upon himself to analyse the introductory lecture of Mr. M'Fadyen, even though correct, cannot be received as evidence of the scope of the whole lecture. In such a lecture, it was proper enough for the learned gentleman to detail the various theories adopted by different authors regarding the creation; but I appeal to the hundreds who were present on the occasion, (and 'An Observer' admits he was not so), whether the lecturer did not refute every sceptical speculation, and triumphantly vindicate the Mosaic account. And I may farther confidently affirm, without fear of being contradicted by the numerous and respectable class of Mr. M'Fadyen, that he has permitted no proper opportunity to pass without elucidating and enforcing the truth of the divine record, and with persuasive eloquence expatiating on the wisdom and goodness of the Creator.

J. W.

Virginia-Street.

AIR-BED.

MR. EDITOR,—In 1821, an ingenious Somersetshire mechanic obtained a patent for a very original and useful invention, the air-bed, which I will shortly describe. The case is varnished with a composition of oil, Indian rubber, and turpentine. It is quite impervious to air, flexible, and may be folded without injury. The air is forced through a tube, and prevented from returning, by means of an air-tight stop-cock. The apparatus is kept below the bed; and by drawing cords, placed like bell-ropes beside the pillows, the person in bed may either make it soft, or hard, by diminishing or increasing the quantity of air within. The bed may be cooled by changing the air, in the same manner. These beds are free from all dust; a great advantage, which even the very best feather or down beds do not possess; by which rooms and furniture may be kept clean with less labour. They require no making-up, and are so light and portable that they may be carried in a great-coat pocket. These beds may, therefore, be of great use to travellers and soldiers, as well as to the public in general; for a good bed is a great luxury, either to the sick or healthy. I shall conclude by merely enquiring, if these beds are for sale any where in Glasgow—what is their cost—and if they have answered the expectations of the patentee, or the public?

L. E.

Dumbarton, 8th March, 1824.

ON REFRACTION.

MR. EDITOR,—Having nothing new to communicate on the straight-edge query, I have not taken up the pen under the impression that I should defend the opinions I already sent you. My intention is to correct your late Correspondent, 'Mechanicus,' in his view of refraction. In page 171, after saying that refraction explains the phenomenon stated by 'An Observer,' he proceeds—"Any person conversant with astronomy would have informed him (S.) that the sun and all the heavenly bodies, when near the horizon, appear several minutes

higher than their proper place, and that, in consequence, the sun is seen before he reaches the horizon in the morning, and after he is below it in the evening." All this I believe as matter of fact; but I deny that it follows, that the visible horizon is apparently raised so much by refraction, and this is what it ought to be in order to solve the question. A moment's reflection will convince 'Mechanicus' that the visible horizon cannot be so much affected by refraction as the heavenly bodies are; for, if it were, how could these bodies appear above it, when they are really below it?

The laws of refraction, as confirmed by experiments, also show us, that terrestrial objects cannot be affected by it as much as the celestial bodies are. Your Correspondent, no doubt, knows, that light is refracted when it passes obliquely out of one medium into another of different density. Of course, as the media through which the light of the sun passes before it reaches the visible horizon, are more varied in their densities than those which are situated between the horizon and the spectator, place him where you will, terrestrial objects (the farthest of which is the sea or land in the horizon) cannot be affected in the same degree as the sun. I say, to the same degree, for there is such a thing as terrestrial refraction, although writers are not agreed what allowance ought to be made for it.

Dr. Maskelyne, in taking the height of mountains, estimated the error occasioned by refraction at 1-10th of the distance at which he made his observations, expressing that distance in degrees of a great circle.

Legendre allows only 1-14th, while, according to Dr. Hutton, "the English measurers, Col. Williams, Capt. Mudge, and Mr. Dalby, from a multitude of exact observations made by them, determine the quantity of refraction to be the 12th part of the distance."

Perhaps the different states of the weather and atmosphere may, occasionally, make all these allowances correct; but though 'Mechanicus' should take the largest, he will, I am convinced, find that it will not much alter the matter. Nay, it is my opinion, that, in making observations according to the case in debate, refraction will only have the effect of extending our view, without raising the visible horizon in the least. Perhaps some of your Correspondents may be able to confute, or confirm, this opinion. To your 'Working Man' I would fain say a few words, but confess myself incapable. When it is once proven that we dwell on the concave surface of a spherical shell, then he may expect a rational answer to his query. S.

Paisley, 15th March, 1824.

QUERY.

Edinburgh, 6th March, 1824.

MR. EDITOR,—Almost every one has heard of the strange boast of the far famed Archimedes, when he said, "Give me a place to stand upon, and I will move the earth." This saying is often quoted, by way of simile, when speaking of any great movement in the moral or political world, and in such a way as to make us believe it to be impossible. Now, it may be an interesting problem for some of your learned and numerous Correspondents, to calculate what time it would require to raise the earth to the height of six inches by means of a lever long enough to be moved by one man, and placed according to the great philosopher's wishes; and supposing the end of the lever to be pulled down with the same velocity as a stone falls from a height at the surface of the earth.

Your's, a Constant Reader,
R. G.

A VARNISH FOR POLISHING WOOD.

The wood must first be very well polished; because, if the varnish brings out the beauty of the wood, it does the same by the defects. When it is well polished, the following varnish may be applied:

Take some very pure shell lac, powdered, and dissolve it in alcohol, (double the quantity of the alcohol to the lac employed, is a very good proportion,) expose it to a heat of about 112 deg. and agitate it every three hours, until it has acquired a proper consistence.

This varnish has no body in it that makes it liable to crack, as the most of the varnishes have. Mix two parts of varnish with one of olive oil; then, with a piece of fine linen, formed into a sort of pallet, rub it over the wood, with great force and pressure, but always in the direction of the fibres of the wood; cover the whole surface of the wood with a slight coat; then leave it to dry, which it does very quickly; then apply a second coat, a third, and, if necessary, a fourth; when it is dry, a lustre is given in the following way:

Steep a piece of linen in a mixture of olive oil and tripoli, and rub the wood hard with it until the varnish has acquired the proper degree of brilliancy; to give it the last polish, rub it with a piece of fine soft leather.

This varnish may also be applied to bodies that do not offer an even surface, but it must be made thinner, and applied with a brush, and polished as above.

The only fault of this varnish is, that it gives the wood a brownish colour; for which reason, it may be applied to varnish mahogany, walnut, and cherry-tree; but if colour is not of importance, it may be applied with success to many different sorts of wood. J. L.

Glasgow, 11th March, 1824.

WET DOCK.

A Correspondent re-proposes our plan of erecting a wet-dock for the accommodation of vessels in the river, see No. II. with this addition, a "bridge of suspension," be erected to diminish the expense of cartage. He also proposes to erect "strong breast-work along the south edge of the present channel, and corresponding breast-work to form the north side of the dock," leaving a "space between them of 30 feet in width," in the form of a tunnel, to allow the water to escape, in the event of a flood. After this, however, he proposes to fill up a great part of the tunnel by ramming in a great "row of cast-iron pillars to support the roof," which, he says, should be made of "iron joists planked with wood." Sluices being placed upon this tunnel, openable upon the "approach of a flood," and "flood-gates upon the dock," for the same purpose, would render this plan, in his opinion, the best that has yet been proposed. There can be no doubt that this plan, complicated though it be, "is preferable to one which," he says, "is in agitation," viz. "the cutting of a new channel on the south side of the river, similar to the present;" a plan "which would divide the stream at all times, and not afford any proper accommodation for such vessels as it is in contemplation to bring to our harbour, by means of the improvements to be executed in the river."

We consider the plan already referred to above, as superior to any of them; we, however, leave those who are most interested in the matter to judge for themselves. It would be well, indeed, if, in this case, as in many others, the constituted authorities would employ men of acknowledged abilities to plan and execute such important undertakings, without hearkening to the advice of any quack pretender, who may set up for a connoisseur in such matters, though he may know just as much of them as Don Quixote's trusty squire knew of knight-errantry.

CREAM.

A Correspondent has sent us a long article upon a fact, which, he says, "is well known to every dairy-maid;" viz. "that the *afterings*, or milk last drawn from the cow's udder, is much richer than the rest." And he gives a very tedious and learned explanation of the reason, of which the sum and substance is contained in the following words, viz. "that the *afterings* are richer than the rest of the milk in a cow's udder, for the same reason that cream is richer than skimmed milk; because, being more oily, its specific gravity is less, and, consequently, it swims on the top."

OYSTERS.

A Correspondent proposes that "three or four hundred pounds should be raised by subscription, to purchase 500,000 oysters, to be tumbled overboard, upon the bank in the river, extending from Dumbarton Castle to Greenock, for the purpose of obtaining a native supply;" and the reasons he gives for the success of this plan are, "that mussels thrive there already;" and "that the rivers of France were destitute of fish, until supplied from those of Scotland;" and "that oriental plants have thriven in the West Indies;" and finally, "that it would afford employment to many."

PEPPERMINT, &c.

A Correspondent proposes that "peppermint and carroway seeds should be cultivated in the Highland glens," instead of heather; and wishes that some of the Highland Lairds would "favour this Magazine with a register of the heat for a run of five years." He also advises them "to look better after their minerals;" these minerals turn out, after all, however, to be only "free stone," which he advises them to "quarry and sell," like "bricks, or logs of wood."

BLACK INK.

A Correspondent, who writes a capital hand, and employs fine black ink, "wishes a recipe for *good black copying ink*," on behalf of "a great number of the most respectable merchants in this city."

NEW POWER.

A Correspondent, in Tradeston, proposes to supersede the use of Steam-engines, especially in navigation, by means of a Water-press, furnished with cylinders and pinions, and cranks and wheels, after the manner of clock-work; which, he thinks, "would carry a vessel at the rate of thirty miles an hour, and enable her to reach New-York in a week, and the Brazils in a fortnight; to double Cape Horn, and touch at Lima in three weeks; and to make Port-Jackson, in New Holland, in a month."

QUERIES.

1. What is the best mode of preserving the gloss on polished metal, from the effects of damp and smoke?—D. L. M.

2. What is the best method of bending a tube of malleable iron, without crushing, or cracking it; supposing, for example, that the thickness of the iron was 1-16th of an inch, and the bore half an inch?—W. T.

MISCELLANIES.

ON THE MANAGEMENT OF THE MECHANICS' LIBRARY.

Nothing can tend more to promote the general interests of science, than to have extensive and well selected libraries, connected with all Classes of this description. Great as the improvement is, which public lectures, illustrated and enforced by appropriate experiments, are calculated to impart; yet it is little compared with what it must be, where the student accompanies the professor at every step of his course, with the perusal of works, in which the subjects embraced by the lectures are ably discussed. It is for this reason, that we wish to see all libraries, connected with institutions for the improvement of mechanics, well furnished with approved works on the subjects to which the lectures refer.

To render these libraries as beneficial as possible, the utmost care should be taken to put them under good management, with respect to the giving out and taking in of books. In this the convenience of the readers should be not a little consulted. Where the benefits of the library cannot be enjoyed, without mingling in a crowd, enduring a great deal of pressure, and consuming much precious time, many persons will be induced to forego the advantage, rather than submit to the trouble and inconvenience of taking out books. Complaints of this kind are often made, with regard to the management of the libraries connected with the Mechanics' Classes of this city. The cause of these complaints might, we conceive, be easily removed. Instead of taking in the books on one evening and giving them out on another, as is done at present, would it not be for the advantage of every one, to take in and give out at the same time? By adopting such an arrangement, the readers would require to go but once to the library, whereas, at present they must either go twice, or submit to pay a fine; now, on the proposed plan, the number of those who would go to the library on the same evening would be greatly diminished, and the confusion arising from crowds would be avoided.

But it may be said, that it would require more time to serve each individual, if he were both giving in and taking out books at the same time, than if he were only taking them out. This is quite undeniable; but, then, it must be remembered, that the time in this case would not be so great as to amount to the time requisite for giving in and taking out books on separate evenings as at present. By this mode, one opening of the library would be sufficient; and, if, at the moment, the books returned were marked off, those to be given out could be entered. Here there would be a great saving of time and labour to the clerk; and he is seldom, it is said, able to keep pace with those who are attending solely to the receiving and delivering of the books. There is still another consideration, which ought to be of some weight in this case, and that is, that according to the present system of management, every one must, at least once a week, or once

a fortnight, lose the use of the library for a whole evening; and this, to those whose only time for improvement is in the evening, after the hours of labour are over, may be matter of some moment. The remedy to the evils here complained of, is certainly easily applied; and the sooner it is applied the better, as it would remove some obstructions to the wider diffusion of scientific knowledge.

C. R.

POISONS, AND THEIR ANTIDOTE.

Quicksilver.—Mercury, in the state of vapour, is poisonous, and is well known as such, in gilding and some other arts, where the workmen are exposed to it. Tremor of the limbs, leading to palsy, are the most common effects. The more violent are, salivation, with ulceration, colics, asphyxia, hæmoptysis, asthma, atrophy, apoplexy, and death. On some occasions, quicksilver taken internally has proved a poison. On others it has proved innocent, and these differences of result seem to depend on the state of the intestinal fluids, and the length of time it remains in the body.

Arsenic.—Some of the salts of this metal form the most violent poisons with which we are acquainted. It is the poison also whose effects are best known, as it is the most frequently resorted to for purposes of murder or suicide; being often also swallowed by mistake. The poisonous preparations from it are, the white oxide, or arsenious acid, the arsenical acid, the arsenites, and the arseniates, the red and the yellow sulphurets, the black oxide, and the vapour. Of these, the white oxide, commonly called arsenic, or the arsenious acid, is the most common.

Arsenious Acid.—This acts both externally, and internally, and produces death in a very short time. The exact mode in which it operates on life, is not well agreed on, but the general symptoms produced are the following: An austere taste, with spitting, constriction of the throat, grinding of the teeth, hiccup, nausea, and vomiting, the matters being brown or bloody. Then anxiety, fainting, burning heat in the stomach, with inflamation of the mouth and throat, great irritability of the stomach, and black evacuations. The pulse is small, frequent, irregular, sometimes slow and intermittent, *with a burning heat* over the body, and an inward sense of the same; yet occasionally there is a feeling of icy cold. Palpitations, thirst, fainting, difficulty of respiration, cold sweats, dysuria, or bloody urine, may be added to these. The physiognomy is affected, presenting a lucid circle round the eyes; the body swells, and is covered with a red eruption, sometimes with petechiæ; and, to complete this frightful list, we may add prostration of strength, delirium, convulsions, priapism, loss of hair and epidermis, and finally death. It is true, however, that many of these effects are present in one patient; and sometimes death has been produced without any other symptom than previous faintings.

The visible effects of arsenic upon the body after death, resemble those of corrosive sublimate. Erosion, or inflamation of the stomach, is not necessary for the production of death. Such symptoms must not, therefore, be depended on in cases of judicial examination.

The poison which has been used must be procured in the way recommended for corrosive sublimate, and examined by the well known tests to be found in the chemical history of this substance.

Treatment of the Patient.—No chemical substance yet tried is an antidote to arsenic in its solid state. All solutions are rendered inert by the hydrosulphurets; but the poison is so rarely given in this form, that these are of no practical use.

The first part of the treatment is to expel the poison by vomiting, and by the same substances recommended in the case of corrosive sublimate; to which may be added, tickling the throat by means of a feather. This alone has sometimes proved successful. In all cases, the fuller the stomach is of any fluid, the less violent are the effects of this poison. The metallic emetics only add to the mischief. Oils and fat substances are injurious, as has been fully proved by experiments on animals. In the liquid state of the poison, lime water may be useful, but not in the solid. Theriaca, and the numerous vegetable antidotes recommended, are useless, except for the quantity of fluid in which they may be given. The medical treatment, as in the case of mercury, is formed on the antiphlogistic plan.

The arsenical acid, and the arsenites and arseniates, are all attended by similar symptoms, but they require no farther remarks.—*Ed. Encyc.*

ANATOMY.

Though it is only the mechanical operations of the human frame that properly come under review in our pages; yet we cannot refrain from noticing the nearly-simultaneous publication of two pamphlets, in this city, on the same subject; viz. the necessity of procuring subjects for dissection. The one, by 'Aliquis,' is entitled, "Remarks on the Question, Whether there are any circumstances in which the Lifting of the Dead is justifiable;"* and the other, by Dr. Mackenzie, is entitled, "An Appeal to the Public and to the Legislature, on the necessity of affording Dead Bodies to the Schools of Anatomy, by Legislative Enactment." The authors of these publications seem to coincide, in a wonderful degree, in expressing their opinions upon this subject; and, indeed, we could point out a similarity of illustration in many passages so striking, that we would be led to think the authors had interchanged ideas, did we not know the fact to be otherwise. The former is more adapted to the consideration of the general reader, being interspersed with very singular, and, not unfrequently, very happy similes drawn from the common affairs of life. The latter is well adapted to convince *our* readers of the necessity of the case; as many of the illustrations are rendered lucid by the comparison of the human frame to an engine, or fine piece of mechanism. We have only room for the concluding sentence of each.

"We would suggest, that all who forfeit their lives to the laws of their country; all who die in the hulks, (overseers of course excepted;) all who die in our hospitals, and remain for a stated time unclaimed, should be given for dissection; or let us have an importation, sufficient to supply all our institutions at a price.

"Among the many who compose the first legislative assembly in the world, are there none who can encounter the scowl of public opinion, and bring this interesting topic before the grand council of the empire?"—*See Remarks, p. 16.*

"The subject is of the deepest interest to humanity—it is almost too deep indeed to admit of personal feelings; but I am persuaded that it requires only to be dispassionately considered by those who have the power of remedying the evil, to produce a thorough conviction, that the system of avowed proscription of anatomy, is a system teeming with the most deplorable consequences to society; and that, though some struggles of natural feeling must be encountered, and many prejudices overcome, yet the advantages to be obtained are so vast, or rather the necessity of the case is so imperative, that *any unnecessary delay in making the supply of the schools of anatomy a matter of legislative enactment, would be a vital injury to the best interests of the country, and of mankind at large.*"—*See Appeal, p. 36.*

* The Profits arising from the sale of this Work are to be given to the Royal Infirmary.

Action of Steam on Solutions of Silver and Gold.

The following observations on the action of steam on solutions of silver and gold, were made by Professor Pfaff, whilst investigating the volatility of muriates contained in boiling water. When the vapour of pure distilled water is made to pass through a solution of nitrate of silver, the solution assumes all the shades between yellow and dark-brown, according to its concentration, and the time the steam has passed through it. When the solution has acquired 212 deg. the colour increases rapidly. If several glasses are connected, and, successively, raised to the boiling point, by the steam passing through them, all become coloured. Nitric acid destroys the colour of this solution of nitrate of silver, and whilst the steam is acting, oxygen is disengaged. When steam is passed through a solution of gold, a blue liquid is produced, like that obtained by adding oxalic acid to a solution of gold. Thus, it seems proved, that the steam acts in producing these effects by deoxidizing the salts of silver and gold. Muriate of platina, or either of the nitrates of mercury, were unaffected by similar treatment.—*Journal of Science.*

NOTICES TO CORRESPONDENTS.

Communications from 'Jonathan Slidevalve,' I. A., J. C., and J. H. will be inserted.—D. L. M.'s first query will be answered by and bye.—Ω. under consideration.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement which is the subject of their notice.

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THE GLASGOW
MECHANICS' MAGAZINE.

"On Europe's lap is pour'd the varied store
Of every climate, and of every shore.
For her Arabia gives her rich perfume,
And labours for her eye the Persian loom;
For her the Indian culls with fainting toil
The spicy harvests of his sultry soil."—*Pye.*

No. XIII. *Saturday, 27th March,* 1824. Price 3*d.*

VERTICAL SECTION OF AN INDIAN STILL.

Fig. 1. *Fig. 2.*

INDIAN DISTILLATION.

Of the Method of Distilling, as practised by the Natives at Chatra in Ramgur, and other Provinces, with very little variation.

The body of their still is a common, large, unglazed, earthen jar, nearly globular, about twenty-five inches in diameter at the widest part, and twenty-two inches deep to the neck, which rises two inches, and is eleven inches wide at the mouth. This jar was nearly half filled with fermented Máhwah flowers, that swam in the liquor to be distilled.

The jar was placed in a furnace, not the most artificial, though seemingly not ill adapted to give great heat, with very little fuel. The furnace was made by digging a round hole in the ground, about twenty inches wide, and three feet deep; an opening was cut in the front, sloping down to the bottom, about nine inches wide, and fifteen long, to admit the wood, and form a passage for the air. On the side, another small opening was cut, about four inches by three; the jar, when properly placed, formed one side of this aperture, which served as a passage for the smoke. The bottom of the earth was rounded in the form of a cup. The jar was then placed in this, and covered above, all round, with clay, except at the two openings, till within about a fifth of its height; when their furnace was completed.

In this way, a third of the surface of the body of the still, or jar, was exposed to the flame when the fire was lighted; and its bottom being two feet from the fuel, a capacious hollow was left between them; when the wood, which was short and dry, was lighted, it was nearly all converted into flame, which, circulating on so great a surface of the still, gave a much stronger heat than could otherwise have been produced from so little fuel; a consideration well worth the attention of a distiller, in our country, where firing is so dear. Here, indeed, particularly where coal is used, it would be better, no doubt, to have a grate; and to allow the air to enter from below. Some benefit might also result from making the body of the still of earthenware. Lighter substances, indeed, are well known to transmit heat more gradually and slowly than the more solid, such as metals; and may not earthen vessels, on this account, be less apt to burn their contents, so as to communicate an empyreumatick taste and smell to the liquor that is distilled, a circumstance so often, and so justly, complained of in this country?

Their furnace being thus made, and the body of the still placed in it, a vessel, called an adkur, was luted on to its neck, with moistened clay: this formed a cover for the body of the still, with a suitable perforation to let the vapour ascend from the under part of the alembick. The adkur was made with two earthen pans, having round holes in the middle about four inches diameter; and their bottoms being opposed to one another, were cemented together with clay; thus forming a neck of junction of about three inches, with the small rising on the upper pan. The lowest of these was made shallower, and about eleven inches wide, so as to cover exactly the opening at the neck of the jar, to which it was luted on with clay. The upper pan was about four inches deep, and fourteen inches wide, with a ledge round the perforation in the middle, about half an inch high, forming a gutter to collect the condensed spirit as it fell down; to allow the spirit to escape, a hole was made in the pan,

to which a small hollow bamboo, about two feet and a half in length, was luted on, to convey it to the receiver below. The upper pan had also another hole in it, about an inch square, at a quarter of its circumference from the former one, below it, to let off the water employed in cooling.

Their adkur being thus fitted to the jar, they completed the alembick by taking a copper pot, such as we use in our kitchens, about five inches deep, eight wide at the mouth, and ten at the bottom, which was nearly flat; and, turning its mouth downwards, over the opening in the adkur, they luted it on to the inside of the pan with clay.

For their cooler, they raised a seat at the back of the furnace, about a foot higher than the bottom of the copper pot. In its side, they made a round hole, about half an inch in diameter, to which they luted on a short tube of a like bore; they then placed the pot, and directed its spout, so that, when filled with water, it threw a constant and uniform stream, from the centre of the bottom of the copper pot, whence it was diffused, pretty completely, over its whole surface; and, the water falling into the upper part of the pan of the adkur, it was thence conveyed through the square hole, by a trough luted on to it for that purpose, to a cooling receiver a few feet from the furnace; from which they took water to supply the upper pot, as occasion required.

As their stock of water, however, in this sort of circulation, was small, being only about eight gallons, it became hot too soon; yet, in spite of this disadvantage, which might have been so easily remedied, as well as the shortness of the conducting tube, which had nothing but the common air to cool it, there *ran a stream of liquor from the* still, with very little vapour rising from it; which was superior to stills of a much larger size, fitted with a worm and cooler. In about three hours after lighting the fire, they drew off fifteen bottles of spirit; which is more than could have been obtained, in our way, from a still of twice the dimensions.

The convenience of a worm and cooler, which are expensive, has been often experienced; and if these could be avoided in this simple way, which might easily be improved, the hints here offered may be of some use. The thin metal head is certainly well adapted to transmit the heat to the water, which is constantly renewed; and which must absorb in the fastest possible manner; whereas, in our mode, the water being confined in a tub, which, from its porous nature, must in a considerable degree rather retain than disperse the heat; whence the heat soon accumulates in the tub, and renders it very hot; and, though renewed pretty often, it never cools the vapour in the worm so expeditiously and effectually as is done by their more simple and less expensive apparatus.

Of the superior excellence of metal, in giving out heat from itself, and from vapour contained in it, we have a very clear proof in what is daily performed on the cylinder of the steam engine; for, cold water being thrown on it when loaded, the contained vapour is constantly condensed; whence, on a vacuum being thus formed, and the weight of the atmosphere acting on the surface of the piston attached to the arm of the balance, it is made to descend, and to raise the other arm that is fixed to the pump; but, this being somewhat heavier, immediately sinks again, which carries up the piston, while the cylinder is again filled; and

thus, by alternately cooling and filling it, is the machine kept in motion; the power exerted in raising the pump-arm being always in proportion to the diameter of the cylinder, or to the surface of the piston, which is exactly fitted to it, and on which the pressure acts.

The contrivance, too, of making the under part of the alembick, or upper part of the adkur, of earthen-ware, (where the condensed vapour is collected,) of such a great thickness, and of course at so great a distance from the heat in the body of the still, is well calculated to keep the spirits as cool as possible, when collected and running off.

By thus cooling and condensing the vapour, likewise, as soon as it rises, a constant vacuum is made, and that steam rises faster, and water boils with much less heat, when the pressure is taken away from its surface, is an axiom in chemistry too well known to need any illustration; the latter boiling in a vacuum, when the heat is only at seventy degrees of Fahrenheit's thermometer; whereas, in the open air, under the pressure of the atmosphere, it requires no less a heat than that of two hundred and twelve, ere it can be brought to the boiling point.

We may farther observe, the superior excellence of their method of condensing the vapour so effectually and speedily in the alembick, to our method, in a worm and cooler, not only from the reasons already adduced, but from the small stream of vapour that can be forced into the worm, when it is condensed gradually as it descends; and above all, from the nature of vapour itself, with respect to the heat contained in it, which was proved, by the very ingenious Dr. Black, to *be greater, by far,* than was imagined, *before his discoveries.* For he has shown that vapour is in the state of a new fluid, where water is dissolved by heat: and all fluids, as he has clearly demonstrated, on their becoming such, absorb a certain quantity of heat, which becomes what he very properly calls latent heat; because this heat does not appear either to the senses or to the thermometer while they remain in that liquid state: but shows itself immediately by its effects upon their changing their form from a fluid to a solid; as on water becoming ice, or metals fixing, and the like. In the solution of salts, also, there is an absorption of heat, as we daily experience in the cooling of our liquors, by dissolving saltpetre in water; and this he has found to be the case with water itself, and other fluids, when passing into a state of vapour by boiling. From the most accurate and judicious experiments, indeed, he inferred, that the heat thus concealed in vapour, raised by boiling from any given bulk of water, would be fully sufficient, if collected in a piece of iron of the like size, to make it perfectly red-hot. What then must be the effect of so much heat communicated in our way of distilling to the worm, and the water in the tub, will be sufficiently evident from what has been said, to prove that we have hitherto employed a more defective method than we might have done, with respect to cooling at least, both in making of spirits, and in other distillations of the like kind, where a similar mode is adopted.

The poor ignorant Indian, indeed, while he with wonder surveys the vast apparatus of European distillers, in their immense large stills, worms, tubs, and expensive furnaces, and finds that spirits thus made by them are more valued, and sell much dearer than his own, may very naturally conclude, and will have his competitors join with him in opinion,

that this fact alone must surely be owing to their better and more judicious manner of distilling with all those ingenious and expensive contrivances, which he can no ways emulate; but in this, it would appear, they are both equally mistaken; imputing the effects, which need not be controverted perhaps, to a cause from which they by no means proceed; the superiority of their spirits not at all arising from the superior excellence of these stills and furnaces, nor from their better mode of conducting the distillation in any respect; but chiefly from their greater skill and care in their right choice, and proper management of the materials they employ in fermentation; and, above all, as I apprehend, from the vast convenience they have in casks, by which, as well as from their abilities in point of stock, they are enabled to keep their spirits for a certain time, whence they are mellowed and improved surprisingly both in taste and salubrity.

With respect to the latter improvement, it in general seems to have been but too little attended to, where a due attention to it might be of the greatest use. For nothing is more hurtful to the body, and to the nerves especially, than fresh drawn ardent spirits; and this is owing evidently to the principle of inflammability, or alcohol, of which, with water, they are mostly made up; and which being then in a more loose and detached state, is less assimilated with the other principles than it afterwards becomes in course of time. By time, indeed, it is gradually not only more assimilated, but at length changes its nature altogether, so as to become, instead of what was at first so pernicious, a benign cooling liquor. When the spirit is strong, the change, it is true, goes on more *slowly and imperceptibly*; yet, as a partial alteration is only wanted to mellow it for use, a few years keeping would be sufficient to answer the purpose; and to prevent any other from being sold than that which had been kept a certain time, is a regulation well worth the consideration of the legislature.

That the noxious quality of fresh drawn spirits is chiefly owing to the cause assigned, a little attention, and comparison of the effects that are uniformly produced by the principle of inflammability, wherever it is met with in a loose and weakly combined state, as it is in them, will easily convince us; whereas, when fully assimilated either in spirits or with any other body, it becomes entirely inert and useful, more or less, either for food or physic. Thus we find it in putrid animal substances, when it lately formed part of a healthy body, being now detached, or but weakly united with air, exhibiting a most offensive and pernicious poison; though this absorbed again by a living plant, is presently changed into good and wholesome nourishment. In like manner, sulphur, which is a compound of this principle alone, united to a pure acid, the most destructive to all animal and vegetable substances, yet, it being here perfectly inert also, may be taken into the body with safety; when, if loosened either by heat, or by an alkaline salt uniting with the acid, its noxious quality is presently made perceivable.

Many other instances of a like nature might easily be added, but every one's experience will sufficiently evince the propriety and utility of putting an entire stop, if possible, to the sale of what ought to be so justly prohibited; and this, in its consequences, may even help to lead to other more effectual means of correcting, in a great measure, the

cruel abuse of spirits in general, that has been long so loudly and so justly complained of amongst the soldiers, lower Europeans, and servants in India, where the very worst, and, indeed, poisonous sort of them is daily sold at so very cheap a rate.

The principles on which this mode of distillation is founded, especially with regard to the way of cooling, are so striking and just, that in many other distillations besides those of spirits and waters, they may be employed with very great profit and advantage. Much benefit may result from a like process in raising the finer aromatics, while the heat contrived, as in our mode, besides impeding the distillation, must, from its long action on such subtile bodies, probably injure them greatly in the essential quality on which their excellence depends: and upon this very account, the greater quantity obtained, and the superior quality of the oil of roses made in India, is owing chiefly, if not entirely, to their more judicious manner of extracting it. For with us, the still, being of metal, may, in the first instance, impart too great and too sudden a degree of heat; and next, the oil continuing so long in the vapour, and being much compressed, may, in so delicate a subject, not only almost entirely unite it with the water, so as to render the separation impracticable, but may at the same time alter its essence so completely, that it cannot appear in the state in which it otherwise might have been found had the operation been better conducted. It is also stated, that, in distilling the oil of roses at the places where they make it best, they use also along with their roses, sandal wood, and some other aromatics; without which, it is plain that the roses could never, of themselves, be made to afford such an exquisite oil.

[The engraving in the front of this Number, exhibits a vertical section of an Indian Still, &c. as described in this article.]

SOLUTION TO THE GEOMETRICAL PROBLEM.

Mr. Editor,—The following is a solution to the problem that appeared in your Magazine for March 13, 1824.

By Geometrical Construction.

On the given diameter, D Q, (fig. 2.) describe the circle, D A Q, in which, from D, insert the chord, A D; on the line, A D, describe the segment of a circle that contains the given angle, A S D, and complete the circle. From A, set off the arc, A F, equal to twice the measure of the given angle, A S P. Draw F B, and produce it to S; the point, S, is therefore determined. Join S A, S D, A P, D P, and what was required is done. The demonstration is evident.

By Trigonometry.

The figure being constructed as above, draw D F, and A F. The angle, A S D, is given, therefore, A F D is known, being in the opposite segment of a circle; also, A S P (A S F) is equal to A D F, for they stand upon the same arc; and for the same reason, P S D, (F S D) is equal to F A D: therefore,

Sine A F D : Sine F A D : : A D : F D, and

$$BD + FD : BD \backsim FD :: \text{Tan.}\ \frac{DFB + DBF}{2} : \text{Tan.}\ \frac{DFB \backsim DBF}{2}$$

Whence, the four angles meeting in B are found, from which the rest are easily obtained.

I see no method of solving it by Algebra, unless Trigonometry be implied. J. H.

Fisherrow, Musselburgh, March 16, 1824.

We thank our Correspondent for his very elegant solution; and beg to inform him, that this problem may be easily solved by an application of the Arithmetic of Sines.

ON CALORIC AND ITS MEASURE.

The dilatation of solid bodies, particularly of metals, is very small, while they are still far from the state in which they melt; yet its effects become sensible in a vast variety of daily experiments.* In great water-conduits, where pipes of cast metal, joined together by iron screws, are employed, the difference in the temperatures of winter and summer, produces such a variation in the dimensions of this long metallic bar, that it is necessary to place, at alternate distances, some pipes, constructed in such a manner as to slide into one another, and thus yield to the effects of the alternate dilatations and contractions, without which, the whole column would infallibly be broken. Apparatus of this kind are called compensators. It is also necessary to employ them in the construction of iron bridges.† It is

* The amount of the dilatation of metals becomes very useful to determine, in certain cases, the change of dimension to which astronomical instruments are liable. Thus, in measuring a base for the grand operation of the meridian of France, Borda sought to elude the uncertainties arising from expansion of the measuring rods, by combining metallic bars, so that they indicated, of themselves, their variations of temperature and of length. A rule of platina, twelve feet long, was attached by one of its extremities to a rule of copper somewhat shorter, which rested freely on its surface, when placed in a horizontal position. Towards the loose end of the copper rule, there was traced on the platina rule very exact linear divisions, the parts of which were millionths of the total length of this rule. The end of the copper rule carried a vernier, whose coincidences with the platina graduations were observed with a microscope. Now, the dilatations of the platina and copper being unequal for equal changes of temperature, we may conceive that the vernier of the copper rule would incessantly correspond to variable divisions, according as the temperatures varied. Borda made use of these changes to know at every instant the common temperature of these two bars, and the ratio of the absolute dilatations of their two metals. The value of the vernier divisions had been previously ascertained, by plunging the compound bar into water of different temperatures, contained in an oblong wooden trough. It was therefore sufficient to read the indications of this metallic thermometer, in order to learn the *true temperature of the bars in the atmosphere*; and of course, the compensation to be made on the *meter* rods or chains, to bring them to the true length at the standard temperature.

† The force with which solids and liquids expand or contract by heat and cold, is so prodigiously great as to overcome the strongest obstacles. Some years ago it was observed at the *Conservatoire des Arts et Metiers* at Paris, that the two side walls of a gallery were receding from each other, being pressed outwards by the weight of the roof and floors. Several holes were made in each of the walls, opposite to one another, and at equal distances, through which strong iron bars were introduced so as to traverse the chamber. Their ends outside of the wall were furnished with thick iron discs, firmly screwed on. These were sufficient to retain the walls in their actual position. But to bring them nearer together would have surpassed every effort of human strength. All the alternate bars of the series were now heated at once by lamps, in consequence of which they were elongated. The exterior discs

likewise the dilatation of metals which causes the rods of pendulums to lengthen in summer, and shorten in winter, so as sometimes to retard, and sometimes to accelerate their motion, which it is necessary, for this reason, to correct in these two extremes, that the effect of these variations may be prevented, by a process which shall be afterwards explained.*

The dilatations of liquids are much more considerable than those of solid bodies in the same circumstances. A vessel, made even of bronze, being filled with water, and well closed up, so that the water cannot escape by any interstice, and then exposed to a strong heat, will infallibly burst with a great explosion; a fact which proves that the inclosed water expands much more than the substance of the vessel. But to observe these effects with more ease and less danger, take a thin glass decanter with a large body and a narrow neck; fill it entirely, or nearly so, with water, or any other liquid; then bring it near to the fire by degrees, and you will perceive the liquor very soon expanding, rising in the neck of the decanter, filling it completely, and running over the brim, long before boiling takes place. The narrower the neck is, with reference to the capacity of the vessel, the experiment is the quicker, and the effect the more sensible; but nothing is better adapted for these experiments than a glass ball blown at the extremity of a tube, whose interior is

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being thus freed from contact of the walls, permitted them to be advanced farther on the screwed ends of the bars. On removing the lamps, the bars cooled, contracted, and drew in the opposite walls. The other bars became in consequence loose at their extremities, and permitted their end plates to be farther screwed on. The first series of bars being again heated, the above process was repeated in each of its steps. By a succession of these experiments, they restored the walls to the perpendicular position; and could easily have reversed their curvature inwards, if they had chosen. The gallery still exists with its bars, to attest the ingenuity of its preserver, M. Molard.

* When the ball or bob of a seconds pendulum is let down the hundredth part of an inch, the clock will go ten seconds slower in 24 hours; and therefore the thousandth part of an inch will make it lose one second per day. Now, as the effective length of the seconds pendulum is 39.13929 inches, we know from tables of expansion, that a change of 30 degrees of temperature by Fahrenheit's scale, will alter its length about the five-thousandth part, which is equivalent to nearly 0.0078, or the hundredth and twenty-eighth part of an inch, corresponding to about eight seconds of error in the day. The first, the most simple, and most perfect invention for obviating these variations, is due to Graham. The bob of his compensation pendulum consisted of a glass cylinder, about six inches long, holding ten or twelve pounds of mercury. In proportion as the iron or steel rod to which this was suspended, dilated by heat, the mercury also expanded, and raised thereby the centre of oscillation, just as much as the lengthening of the rod had depressed it. M. Biot, with his usual accuracy, has shown, that if the suspending rod were of glass, the length of the cylinder of mercury would require to be 1-10th of the total length of the pendulum, namely, about four inches; but the expansion of iron being greater in the ratio, pretty nearly of three to two, we have hence the length of the cylinder, in the latter case, equal to about six inches. The late very ingenious Mr. Gavin Lowe prescribed, along with a steel rod, a glass cylinder two inches diameter inside, containing 6.4 vertical inches of mercury, weighing ten pounds. From accurate calculation he found, that if such a pendulum should go perfectly true when the thermometer is at 30°, but that at 90° it should go one second slower in 24 hours, it would be remedied by pouring in ten ounces more quicksilver; or, by taking out that quantity, if it went one second faster in 24 hours, when at 90° than at 30° Fahr.; and for 1-10th of a second of deviation in 24 hours, the compensation is the addition or abstraction of one ounce of mercury.

very narrow. When we observe this with attention, we remark, with surprise, that, at the first moment of the action of caloric, the liquor descends in the tube, instead of rising. The reason of this is, that the substance of the glass experiencing the heat first, also expands first, and before the liquid has yet experienced the same influence; but the heat continuing to penetrate the whole apparatus, the liquid begins very soon to expand, and is not slow in gaining upon the glass by the excess of its dilatation.

The effects of dilatation and contraction in aeriform substances, that is, whose constitution is analogous to that of air and vapours, is capable of being made equally obvious to the senses. For example, it is the elastic force of steam, which raises the pistons of steam engines. But to confine ourselves to common experiments, every one has experienced how difficult it is sometimes to introduce a liquid into a phial whose neck is very narrow, as, for instance, those of smelling-bottles are; this arises from the resistance of the interior air, which, finding the narrow orifice of the tube stopped by the small column of liquid which has been introduced into it, is invincibly opposed to its passage. To elude this obstacle, heat the phial, and the air which it contains, while heating, will expand more than the glass; the volume of the phial will no longer be sufficient to contain it; a part of it will therefore be expelled; now dip the phial in the liquid which you would put into it, and, in a few moments, the air remaining in the phial will cool, contract and give place to the liquid which will enter to occupy the empty space, acting, in this instance, under the pressure which the exterior air exercises upon all bodies.

If we carefully measure the dimensions of bodies, after having exposed them to different temperatures, we find, in general, that if the fire has neither altered their constitution nor their nature, they return exactly to the same dimensions which they had at first, however often we have exposed them to these alternate changes.*

This property is observed, for example, in metals, when they are not just heated till they melt, and in liquids, when they are not just heated till they boil. We find, indeed, that clay, and some other substances, seem, on the contrary, to contract when they are exposed to the fire after they have imbibed water; but then they return no more to their first dimensions; which shows, that their contraction is the effect of the drying which they undergo, or from a more intimate combination of their elements, and not a transient effect of heat. Attention must be paid to this phenomenon, in the construction of earthen and porcelain vessels, otherwise they will not have, when taken out of the furnace, the form which is intended; but it is obvious, from the explication of the cause, that it forms no exception to the general laws of the dilatation of bodies.

This property, which all bodies possess, of dilating by heat, and returning to the same dimensions when reduced to the same circumstances, presents a very simple and exact means of measuring the variable degrees of heat. It is employed in the most successful man-

* To recognize this property in liquids, they must be observed in tubes closely shut in all parts, so that the heat may not carry off a portion of their substance, in reducing it to vapour. With this precaution, it will be found that they do not change their internal composition,' that is, if they continue to form the same substance which they formed at first, they return exactly to the same dimensions when the same temperature is restored.

ner in the constructions of those instruments called thermometers, that is, *measurers of heat.* They are well known, and in common use; but the principles upon which they are constructed, and which guarantee the certainty of their indications, are not so generally known.

(To be Continued.)

ON THE POWER GAINED by the MACHINE of the *late* MR. CROSS.

A FRAGMENT, written by himself.

[See the Description in No. VI.]

"To explain the plan of managing the accumulated resistances toward the end of the shed, which are so troublesome in all other methods hitherto attempted, some illustration of the nature and properties of the rotatory motion will be requisite, as it is not well understood by the generality of those for whose benefit it is intended.

"The rotator has a screw nail in the face of it, $1\frac{1}{2}$ inches from the centre of motion, on which nail the lower end of the shaft is put; and the upper end is placed on the arms of the trapboard, for communicating the direct motion of the rotator to it, while its own motion is circular. The extent of its motion is one-half round the circle, or 180 degrees, which is somewhat more than $4\frac{1}{2}$ inches for 3 inches of direct motion. Now, it is worthy of consideration, that this mode of moving the harness is best fitted to what is required in practice.

"The properties of the rotary movement will be best understood by dividing it into a number of parts, and calculating the quantity of power at each of these divisions, as the rotator turns round.

"To exhibit the quantity of power, without fractions, as much as possible, suppose that the sum of weight to be raised is 24 lb. The whole of this weight is supported by the rotator, when the shaft, on the face of it, is down at the lowest point; but when it is turned up, it *will lose or gain* power according to the degrees in the following table.

Degrees on the rotators.	Power required in lbs.	Power gained in lbs.
2°	1	24
4	2	12
6	3	8
9	4	6
14	6	4
19	8	3
30	12	2
49	18	$1\frac{3}{4}$
90	24	1
131	18	$1\frac{3}{4}$
150	12	2
161	8	3
166	6	4
171	4	6
174	3	8
176	2	12
178	1	24
180	0	Infinite

"This table shows the relation of the weight and power at each division, as marked in the first, or left hand column, which are degrees of the half circle contained in the rotary movement. The second column, marked lbs. power required, shows the quantity of power the operative has to exert to support the weight, which is supposed to be 24 lbs. The third column, marked power gained, shows how many times the weight is greater than the power that supports it. For example; the rotator, having the 24 lbs. of weight upon it, will rest when the weight

he lowest point of its circum-
e; but when turned about 2
es, 1 lb. of power applied to
readle will bring it to that
; hence the power is $\frac{1}{25}$ of the
t. Again, let it be turned
to the 19th degree, where it
equire 8 lbs. of power to sup-
t, and the power is $\frac{5}{25}$ths of
eight. Let it again be turned
to 90 degrees, then the
and the weight are equal;
se at this point they are
y distant from the centre of
n of the rotator, which is $1\frac{1}{2}$
, and here the shed is just
ay opened; but it will appear,
y turning the rotator farther
power will be gained in the
ratio that it was lost: hence,
it is turned round 180 de-
the weight is completely
n upon the rotator, and the
ive has no weight at all to
n at this point.

Now, it is obvious, by inspect-
e table, that the power at the
ing and end of the sheds is
infinite. The advantages to be
d from this mode of managing
eight at the end of the shed,
onsequently, very great. In
st place, the resistance of the
owards the end of the shed is
means inconsiderable; for the
as, in general, more tension
fully up than when down;
a greater proportion of the
t is upon it in that situation,
the sheds be pressed without
erpressing leaves, the weight
e thereby greatly increased.
though this is a very great
venience in the common way
ening sheds, yet, in this it is
for the power gained increases
higher ratio than the weight,
when brought to its greatest
, the weight is altogether
rted by the machine itself.
the weaver is relieved entirely
the weight *during* the time that the shuttle takes to run across the web. This circumstance is surely of very great practical utility, independently of other advantages involved in this mode of management."

We have thus had the melancholy duty of giving to the public, perhaps the last memorial of a man of singular ingenuity, and one whose inventions in the art to which this country owes most of her wealth, should have procured him a comfortable competency; instead of which he was left to linger and to perish under the severe pressure of poverty. We cannot close this notice, without giving a short memoir of his life:

James Cross was born on the 3d of January, 1779, at a place called Craighead, about a mile and a half from the village of Hamilton. His parents were working people, respectable in their station, distinguished for their industry, sobriety, and the virtuous example which they set before a numerous offspring. He was, from his earliest years, continually troubled with a singularly delicate constitution; and, although bred a weaver to profession, it was always the wish of his parents that he should receive a superior education to enable him to gain a livelihood at some business where little bodily exertion was required. For this purpose, he was sent to school at an early age, where he received the rudiments of penmanship, arithmetic, and grammar. In acquiring these branches of education, he was often eulogised by his master for excelling his companions in school, in punctuality of attendance, and superior attention to his lessons, and especially in his peaceable demeanour. Indeed, it is well known, that, in every engagement where his honour was concerned, he

evinced a manly anxiety to acquit himself with credit. In whatever situation he was placed, in the performance of any duty, he ardently strove to discharge that duty with propriety. Contrary to the wishes and expectations of his parents, he showed no predilection for the particular line of business which they wished him to follow. It may be said, therefore, that though he surpassed his school-fellows in learning the common rudiments of education, yet he seemed to possess no powerful stimulus which was destined to raise him above the rank of an ingenious mechanic. He was fond of reading, and carefully perused the limited selection of books which he was enabled to procure; and, though not a learned man, in delivering his opinions on any subject, he spoke fluently, and displayed a knowledge of language not common among men of his station. It was particularly amusing, and equally edifying to those who comprehended the nature and value of his observations, to hear him detail the progress of his improvements in loom-work. This was the source and main-spring of his pleasures; for, ever since he had commenced the art of weaving, he showed a never-ceasing propensity to be useful in suggesting and executing what he conceived of essential service to the operative, and to the trade in general. His company was much courted for his pre-eminence in his humble profession, and being extremely affable and communicative, it may be said that his fire-side, when health permitted, was the resort of his fellow-workmen, solicitous of information in the useful art of weaving. It was the pride of his heart, without fee or reward, to give every necessary instruction, and often has he condescended to go to their workshops to give what may be termed practical explanations of his views respecting their trade. For more than twenty years did he conduct himself in this useful manner in the town of Paisley, to the honour of his own name and the no small advantage of the community among which he resided. His fame was universally known in a city celebrated for its excellence in producing the beautiful fabrics of the loom; and it may surely be considered both strange and lamentable, that he should have met with no adequate remuneration for his many and valuable improvements in loom-work.

Mr. Cross departed this life on the 18th current, aged 45 years, leaving a destitute orphan family of four children, (of whom the eldest is only 13 years of age,) to the generosity of the public, and of those who have been benefited by his inventions. We understand that arrangements had been made to give a lecture for Mr. Cross's benefit, which was only delayed by his unexpected death; a circumstance which gives a deeper interest to the object of this lecture, which, we are happy to learn, will take place for the benefit of his children.

AGITABLE LAMPS.

Mr. Editor,—In a late No. of your Magazine, I observed that one of your Correspondents recommended the argand lamp as the best *mode of producing* the greatest quantity of gas, or light, from oil, with the least smell. The following observations upon agitable lamps, which, I assure you, are the result of many experiments, and a number

of years' experience of their utility, may be worthy of a place in your Scientific Miscellany.

The great complaint against all lamps is the disagreeable labour that is required to trim them, and one which must always be undergone when the lamp is supplied by the burner opening; the lamp and the hands employed are so much soiled when additional oil is necessary, that they must be carefully washed every time that it is supplied. This induces the makers to make them deep, that they may contain a great quantity of oil, and require a less frequent supply; a circumstance which infallibly prevents them from burning well.

A good lamp should have two openings, one to charge it with oil, the other for the burner; each should have a screw, not too small. By this means, the lamp can be supplied with oil without soiling the fingers. Whatever be the size of the lamp wanted, it must never exceed three-fourths of an inch deep, and it must be flat at top and bottom. The best form is oval, and the burner must be as near as possible to one end of the oval, which should taper to the size of the screw. This form gives the smallest shadow on the light side. The screw for charging, opening at the other end, should be of the same size, to make it uniform.

When a small light is wanted, a round pipe, with a cotton wick, will answer very well. But should a strong light be required, a flat pipe should be used, with wicks of cotton cloth now made for that purpose.

The wick-holder must be of one uniform width, and *must be made of copper*, because it communicates the heat much better to the oil, is more durable, and the cinder, or residuum does not adhere to it in *the same manner as it does to iron, which often nearly fills up the pipe*, and is very troublesome to clean. The slit for pulling up the wick should not go under the sole of the burner, and there should be no opening below, except the end of the pipe which should go as near the bottom as will allow the wick to be drawn up freely.

The pipe of the burner should be raised five-eighths of an inch above the sole of the burner; this raises the flame above the lamp, and allows the atmospheric air to act on it. When the burner is level, or nearly so, with the top of the screw, it wants air, and, of course, cannot burn freely; it also makes the shade of the lamp larger than when it is raised.

A lamp constructed on this principle, and carefully kept clean, which can be easily done by means of the two openings, will burn exceedingly well. If a wick, 3-4ths of an inch broad, and which never should exceed five inches in length, be used in this lamp, and one of the Glasgow Gas glasses, No. 1., it will burn the smoke, and give as clear a light as the best Argand. To attain to this, however, each of these observations must be attended to, otherwise an imperfect imitation will fail in producing the effect. Under the lamp a small pipe should be made, to hold a picker, which, trifling as it may seem, will be found of great importance in the preservation of cleanliness in trimming the lamp.

I am, Sir,
Your's, G. T.

Glasgow, 22d March, 1824.

We think these are the best lamps, for common use, that we have seen, and intend to procure one for ourselves, from our old friend, Mr. Wylie, the Brazier. Our Correspondent calls them *Agitable*, because one can toss them about the house without spilling a drop of oil.

LETTERS AND QUERIES.

POWER OF SCREW-DRIVERS.

Mr. Editor,—A query respecting the power that can be exerted by different screw-drivers, being proposed in your Eleventh No., the following remarks may be reckoned a satisfactory explanation. If the handles be of the same size, if the screw-driver be kept in a straight line with the nail, and if the same power be applied to the handle of each, there will be no difference between a short and a long one; a long one, however, has, generally, the following advantages:

First, the size of the handle; and, secondly, the more easy application of a person's strength, because both hands can be more conveniently applied; thirdly, it allows him to take advantage of the inclined position more effectually than a short one; that is, if the screw-driver can be inclined to an angle of 15 degrees, for example, and still have a good hold of the nail, and if you make the screw-driver revolve round the nail, keeping the same angle, you will, independent of the power exerted in twisting, act with a lever of about one inch and a half for every six inches in the length of the screw-driver.

This may be demonstrated as follows: Suppose a perpendicular is erected on the head of the screw-nail, then the distance, at right angles from this perpendicular to the handle of the screw-driver, is the length of leverage gained by the inclination *of the screw-driver;* now, the longer *it* is, the greater will this distance be, and, in the same proportion, is the advantage gained. A small deduction, must, however, be made for the angle at which you twist; for, suppose the angle amounted to a right angle, *then no power* would be exerted on *the nail by twisting*, but you would have a much greater power in the handle; for then a lever, the whole length of the screw-driver, would be acting at right angles to the nail.

R. H.

Glasgow, 22d March, 1824.

OIL GAS.

Mr. Editor,—In your Sixth No., S. M. proposes some queries respecting the mode of lighting with oil gas, which N. T., in your Tenth, "endeavours to answer," but, unfortunately, his answer to the third query contradicts his answer to the second. Permit me to make the following observations on S. M.'s queries: the first, N. T. has answered; to the second query, I would answer, that Dr. Fyfe's apparatus might easily be constructed to give 20 cubic feet of gas a night, the size being arbitrary.

To query third—when the flame of the oil gas is properly regulated, the gas is sufficiently pure for "lighting houses," the smoke being occasioned by sulphurous vapours,* which, although predominant in coal gas, are never found with oil gas.

To query fourth—from the scroll of the apparatus, a person might form an idea of the cost, which would be nothing like the price of the patent apparatus mentioned by N. T.

I am, &c.,

I. A.

P. S.—N. T. is evidently in a mistake, in saying "that less light is obtained from oil when made into gas, than when burned in a good argand lamp," the saving, on the contrary, by burning gas, is 25 per cent., as Dr. Fyfe mentioned, when lecturing upon oil gas.

Edinburgh, 11th March, 1824.

We have inserted this merely to give both sides of the question a fair hearing. We are of opinion, however, that our Correspondent has displayed a very limited acquaintance with the subject; in fact, he has not properly answered N. T. at all; and, for our part, we cannot see the contradiction he points out. We

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* A test for detecting sulphurous vapour in gas, may be got by wetting a piece of paper with sugar-of-lead water, and holding it over the gas, it will immediately become black; if the gas is pure, it will be unaffected.

are also aware, that the paper of N. T. contains the result of a very extensive series of observations; and we must say, that the remark of Dr. Fyfe, if correctly reported, would require a more convincing demonstration than mere assertion.

STEAM.

MR. EDITOR,—As none of your Correspondents have yet thought proper to answer any of D. M'L.'s queries, in page 143 of your Magazine, I shall make an attempt to solve the second one, in as few words as possible.

But it will be necessary here to say a little with regard to the properties of steam, and to explain the meaning of the terms that must unavoidably be made use of, to explain a phenomenon which one would almost think paradoxical at first view. It is a well-known fact, that when water is boiling, it absorbs nearly a thousand degrees of heat (940 deg.) before it can be converted into steam, and these 940 degrees of heat are not indicated by the thermometer; this is called by chemists,* the *latent heat* of elastic fluidity; but there is another thing to be taken into consideration, and that is, that when steam is expanded, it, at the same time, diminishes in temperature: *e. g.* if you have a quantity of air, and let it be expanded by removing the pressure from it, it will be necessary, in order to keep up in it a uniform temperature, to supply it with an additional dose of caloric, which will not be indicated by the thermometer; this is called by chemists the *latent heat* of expansion. This is an experiment which cannot well be practised on steam, on account of its liability to condense; however, it is very reasonable to suppose, if we judge from analogy, that it holds the same with regard to steam.

Now, Sir, I should consider the reason—why high pressure steam, issuing from an orifice, does not scald—to be, that it expands, very suddenly, to a great magnitude, as soon as it comes in contact with the atmosphere; consequently, the latent heat of expansion is increased, at the expense of the latent heat of elastic fluidity; therefore, the steam is condensed into the state of water, hence the cloud which is seen, the temperature of which is too low to scald any person who may have the curiosity to try the experiment.

I think, from what has been said, it will be easily understood why the steam issuing from the spout of a tea-kettle, is invisible for some time, namely, that it has little or no expansive force, and, therefore, has no inclination to expand, till its momentum is checked by the surrounding atmosphere, and then it is also reduced to the state of water.

Your's,

JONATHAN SLIDEVALVE.

Johnstone, 17th March, 1824.

* See Dr. Thomson's *System*, from which this account is chiefly extracted.

STILLS.

A Correspondent begs leave to suggest to the distillers of Britain, that stills should be made of fine clay, with wooden heads and wooden worms, for condensation; that these stills would remove the empyreum which, more or less, abounds in whisky; that soda, or potash, might be employed to absorb the essential oil, or if the wash were, in any respect, soured, that quick-lime would answer better, and produce ten per cent. more of product, as it is the essential oil and empyreum which give the great variety of taste to whisky; that a still of 40 or 60 gallons capacity, made of fire-brick, with wooden head and worm, can be constructed for the sum of £3 or £4; and that there is a kind of stone, such as is used for baker's ovens and by makers of steel, that would answer well for this purpose.

FIRE QUERY.

A Correspondent, dissatisfied with the answer to the query respecting the sun putting out a fire, given in a former No., states, that the rarefaction of the air, by the double action of the fire and of the sun, is the cause of the phenomenon. For, says he, "It is well known that a fire will not burn without air, and, also, that heat rarifies the air. Now, the sun's heat, combined with that of the fire, will rarify the air to such a degree, that the fire will go out, because the air is not sufficiently dense to make it burn."

On Tuesday, the Magistrates and Town Council passed a *Seal of Cause*, incorporating the Mechanics' Institution of this City.

The Directors of the Glasgow Gas Company have handsomely voted £5 to the Library of the above Institution.

MISCELLANIES.

RAMSDEN.

It was the custom of this celebrated optician, to retire in the evening to what he considered the most comfortable corner in the house. He would take his seat close to the kitchen fire-side, in order to draw some plan for forming a new instrument, or scheme, or the improvement of one already made. There, with his drawing implements on the table before him, a cat sitting on one side, and a certain portion of bread, butter, and a small mug of porter, placed on the other, while four or five apprentices commonly made up the circle, he amused himself with either whistling the favourite air, or sometimes singing the old ballad of

"If she is not true to me,
What care I to whom she be?
What care I, what care I, to whom she be?"

and in this domestic group he appeared contentedly happy. When he occasionally sent for a workman, to give him necessary directions concerning what he wished to have done, he first showed the recently finished plan, then explained the different parts of it, and, generally, concluded by saying, with the greatest good humour, "Now see, man, let us try to find fault with it;" and thus, by putting two heads together to scrutinize his own performance, some alteration was, probably, made for the better. Whatever expense an instrument had cost in forming, if it did not fully answer the intended design, he would immediately say, after a little examination of the work, "Bobs, man! this won't do, we must have at it again:" and then the whole was put aside, and a new instrument begun. It was by means of such mingled perseverance and genius, that Ramsden succeeded in bringing so many mathematical, philosophical, and astronomical instruments to perfection, as he is universally allowed to have done.

NEW PATENTS SEALED, 1824.

To Thomas Bewley, of Mount Rath, in Queen's County, Ireland, Cotton Manufacturer, for his invention of certain improvements in Wheeled Carriages.—Sealed 24th Jan. Six months.

John Heathcoat, of Tiverton, in the County of Devon, Lace Manufacturer, for his invention of certain improvements in the method of figuring or ornamenting various descriptions or kinds of goods manufactured from Silk, Cotton, or Flax.—24th Jan. Six months.

(To be Continued.)

NOTICES TO CORRESPONDENTS.

We thank J. A. for his remarks, and are of his opinion, that "the subject is not worth minding."—We are much obliged to M. S. for his communications, but cannot insert them without his address.—J. D., A. B., and Beta, under consideration.—Ω. is superseded.—Other Correspondents will be answered next week.

Another claimant for the Invention of the Process for discharging Turkey-Red, has come forward, who dates his invention so far back as the year 1792. While there exists so many contending claims, it is unnecessary for us to make any farther comments, as the public will be able to judge who is entitled to the merit of the invention, from the statements of the parties themselves, which will in future accompany the Magazine.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement which is the subject of their notice.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed.

J. CURLL, PRINTER.

STATEMENT OF CLAIMS

Invention of the PROCESS *for Discharging* TURKEY-RED.

From MR. ALEXANDER HARVEY.

DITOR,—I professed myself
astonished, in my paper to
Ninth No. of the Mechanics'
at seeing a claim laid to the
f the discharging process in
r. Millar;—but I was cer-
nore so, after so bold an as-
n, in your observations on
ou made such concessions as
ng, although with seeming
—" That you were quite
some attempts towards a
ess had been made, but that
t aware of the date of these
hat you were now informed
resumed, with tolerable ac-
d that you were also aware,
mpts which were made never
accomplishing a tolerable
ng process." Let me ask you
any more extensive manu-
ocess of the kind in existence

satisfaction, I will give you
f Mr. Millar's discovery, at
ention he lays claim to, and
it are, I presume, pretty
own; as, I believe, there are
luals who have worn the
fs done in these presses but
nced them to their cost.
d of two plates, one of which
iron, pierced with holes, to
pattern; these holes were
pper or brass tubes, which
round or square, according
; the tubes projected con-
ond the surface of the plate,
ectually to obtain the greatest
ssure round the parts that
ischarged. The other plate
lead, with the pattern cut
correspond with that on the
e natural consequence was,
as the copper or brass tubes were very thin, the two plates acted as a punch, or pair of scissors, and either nipt out the piece altogether, or left it in such a state that at the first washing the figure was generally effectually discharged, by being washed out altogether. This was attributed, by those who bought the handkerchiefs, to the destructive effects of an acid used in the discharge, but any person at all acquainted with the subject knows that this was the real cause. It is somewhat singular, that no reference is made by Mr. Millar, or his advocates, to this circumstance. Ambitious only of originating the invention, they modestly decline the tribute, which is justly his, of having done that for the process which rendered its products, for years, deservedly unpopular. Thus it is that there have ever been found those who, from contriving some fancied improvement upon that which they could never have devised; have attempted, when the lapse of years, in this case of nearly a quarter of a century, has lent an obscurity suitable to their purpose, to elevate themselves above their just station, that of laborious, but often blundering operators, into the dignity and importance of those who have added to the amount of human knowledge, and sum of human conveniency. In the matter in question, the honour which is due to the latter class, is justly the property of Mr. George Rodger, who not only was the first, successfully, to carry an idea into operation, but has since pursued the tract of improvement, till now he has a satisfaction which but few men of original invention are permitted to experience—that of seeing the offspring of their ingenuity and labour in a state bordering upon perfection. And yet Mr. R. does not lay claim to the origin of the invention. But it is true, that he did, in the beginning of the year 1802, without any knowledge of the mode practised by others, at that time, or the apparatus used by them, construct a press, and discharge bandana handkerchiefs, which he sold in Paisley, the same year. All that I wish to establish is, the fact that he did so, which will, in itself, entirely do away with Mr. Millar's claim to the

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r of this article is wrong in his
re he says that the article " Ban-
ncyclopædia Edinensis was written
eith, Esq. The fact is, that the
ten by Mr. John Murphy, of this
ld have no interest in misrepre-
is ready and able to vouch for the
ry one of his statements, to the
the distinguished gentleman al-
han whom there cannot be better
testimony at the time of publica-

origin of the discovery, for which he, so presumptuously, throws himself upon the generosity of the public.

With regard to Messrs. M'Brayne, Stenhouse, & Co.'s presses, I believe they have nothing to do with the present subject, as presses of the same kind were in use, in many parts of the country, long before that period;—and as to Mr. George M'Farlane's inviting Mr. George Rodger and Mr. James Gray to see the presses, it is true they were invited by Mr. M'F., and, before dinner, they were taken to see the works, but they were so hurriedly conducted through the apartment in which the presses were, that they had only time to remark, that there had been two exactly of the same description, and without the slightest difference, at work at Blantyre, for several years before that period. I could here give you Messrs. Monteith, Bogle, & Co.'s reasons for discontinuing the manufacture of bandanas themselves, for the period you take notice of, but that I presume the commercial details have nothing to do with the original discovery of the mode of manufacture.

But to the main point; previous to discussing which, I will extract a few lines from Mr. Millar's letter to ——, Esq. "Near the latter end of the year 1802, Mr. Robert Tweedie inquired, several times, at me, if I thought I could print upon, or discharge Turkey-red, so as it might become a trade. Not long after this, I turned my attention to that object, and, by the middle of Nov. 1802, had the model of a discharging-press at work." Now, Mr. Rodger not only discharged, but SOLD handkerchiefs that he had discharged, *by means of a press, in the month of July, of the same year*, four months before Mr. Millar's model was constructed, as is evidenced by the two subjoined certificates from persons of respectable character, and undoubted veracity, in Paisley, who actually bought the goods in question.* The Turkey-red dyed

cloths from which they were p
by the discharging process, wer
Messrs. H. & R. Monteith
Rodger, for the purpose, on
June, 1802, and their invoice
and letter attached, in which
and explicit reference is mad
operation, as having been alr
scribed to them by Mr. R., is,
tunate circumstance for the
truth, still in existence, and rea
produced.

After the evidence that has bee
ed, your informant may well feel
at having, so dogmatically, ass
your columns, that "whatev
may be claimed for the partial s
these attempts, the process for
ing Turkey-red, the fruit of
ingenuity, and ripe for practic
cation, was the invention of M
Millar, and of him alone."

The grave importance and m
formality of "James Barr, No.
Street," demands a word, in co
When a case, built upon assum
already left without a leg to sta
a supposition, and a vague one
nected with an oracular warni
this sage's, would lend but slen
port; yet what becomes of e
prop, in the face of the statem
which I conclude. Mr. James
being interrogated, in presenc
employer, James Cook, Esq. sa
"he does not know who the th
were who were sent for from Bl
but asserts, that "*an Irish labou*
deceased) had informed him that
posed some men had been sent for
the model."

No. 12, Dale-Street,
1st March, 1824.

And upon the faith of this, he
proper to give Mr. Millar noti
with such evidence your informa
attempt to cast a slur upon the c
of a man (Mr. Adam Bogle) w
have spurned the idea of being a
to any thing so mean—a man w
as much above giving countenan
low an action, as he stood high
scale of honour and integrity in t
mercial world.

I am,

Mr. Editor,

Your's, &c.

ALEX. HA

Glasgow, 22d March, 1824.

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* I certify, that I have seen and bought Bandana Handkerchiefs, discharged by Mr. George Rodger, in Paisley, in the month of July, 1802.

ROBERT HENDERSON.

Paisley, 28th Feb. 1824.

This is to certify, that I have seen, bought, and worn Bandana Handkerchiefs, discharged by Mr. George Rodger, in Paisley, in July, 1802.

WILLIAM GALBREATH.

Paisley, 28th Feb. 1824.

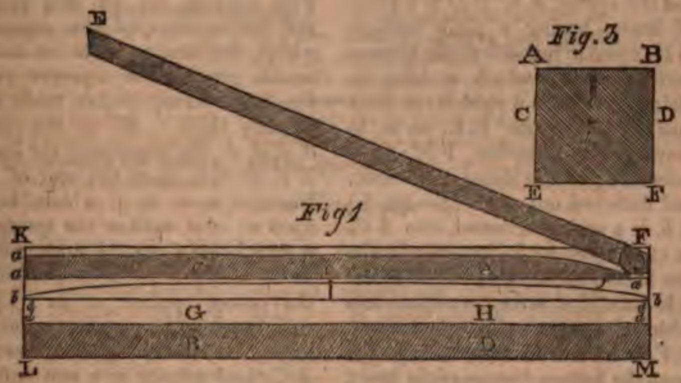
THE GLASGOW
MECHANICS' MAGAZINE.

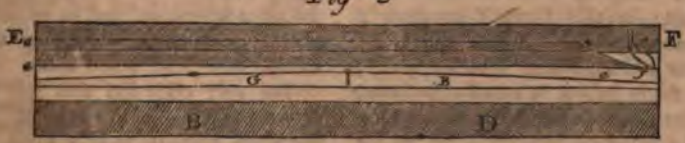
" In sweet astonishment th' impatient mind
Bids her free powers expatiate, unconfined;
From scene to scene in rapid progress flies,
Glances from earth to seas, from seas to skies;
Delights to feel the great ideas roll,
Swell on the sense, and fill up all the soul."—*Potter*.

No. XIV. *Saturday, 3d April,* 1824. Price 3*d*.

TAYLOR & MARTINEAU'S

PATENT COPYING PRESS.





DESCRIPTION OF TAYLOR & MARTINEAU'S PATENT COPYING PRESS.

This is a neat portable instrument, and exhibits a very philosophical combination of the compound lever.

Fig. 1st shows the instrument in a position ready to receive the paper intended to be copied. A C is a piece of ebony, (or any other hard wood,) which moves on the sides of the brass plates, K L, M F, and hollowed out to contain the lever, *a, a, a,* and the spring, *b, b.* B D is a piece of brass, having a plain surface, G H, equal in breadth to the bottom parts of A C, which is likewise plain. *a, a, a,* is a steel lever fixed into the brass plate, K L, so as to move in the direction, F M; it is something of the shape of a razor, and flattened out at *f.* (See fig. 4.) *b, b,* is a spring screwed into A C, at *c,* and resting in two notches in the brass plates, K L, and F M, at *b, b.*—*d, d, d, d,* is the open space into which the paper to be copied is put. E F, is a brass lever, working at *f,* upon the flattened space of the lever, *a, a, a.*—*e,* the journal of the lever, E F. Fig. 2d shows the instrument shut; in this form it occupies a space of about 2 inches square, by 9 or 12 inches long. The lever, E F, is made hollow to admit of its being shut down on the lever, *a, a, a,* and of a sufficient breadth to fill up the space hollowed out of A C. See 1, 2, 3, 4, fig. 4th. Fig. 3d is an end view of fig. 1st, at K L, A C, and B D; the sides of the piece of wood, A C, moving on the sides of the brass plate, A E, F B; *e,* the place for receiving the end of the lever, *a, a, a,* and *f,* the catch for the ends of the springs, *b, b.* The piece, A C, is retained in its place by the spring, *b, b,* even although the lever, *a, a, a,* is withdrawn, which it may be at pleasure, as it is not fixed to the spring, but merely rests on it at *c.* Fig. 4th, the interior of A C, without the lever E F; K F, K F, the sides of A C, (fig. 1st;) *a f,* the steel lever; *b,b,b,b,* the spring under the lever, and fixed at *b, b,* it is about 1-4th of an inch in breadth, and nearly fills the space 1, 2, 3, 4.

To use this instrument, write with copying ink on thin paper, and having damped the paper to which the writing is to be transferred, put both in a proper position into a strong blotter, made sufficiently thick to fill up the space *d, d, d, d.* By depressing the lever, E F, it acts upon the end of the lever, *a, a, a,* at *f,* which, being fixed at *a, a,* strikes the spring at *c,* and forces down the upper piece, A C, with a force in proportion to the power applied at E. Upon withdrawing the pressure upon the lever, E F, the spring, *b, b,* elevates A C, and admits of a new surface of the blotter being pushed forward, which, in its turn, undergoes the same operation, and so on until all the parts of it containing the writing have been acted upon.

The only objection that can be urged against this instrument, is the small breadth it acts upon at once, which can only be the distance at E F, (fig. 3d,) and the lever has to be elevated and depressed a good many times before the copy can be obtained; but, I think, this is more than compensated for, by the very small compass into which the instrument goes, compared with the common rolling, or even with Ruthven's patent printing or copying presses.

S.

GEOMETRICAL PROBLEMS.

MR. EDITOR,—The construction and solution of the geometrical problem, that appeared in your last Number, is perfectly correct as far as J. H. proceeded; that is, till he found the angle A B S, (fig. 2, No. XIII.) and pronounced the rest easily found. Now, I should like that he would show how the cords A P, P D, and the line S P, are to be found without any additional construction. In the meantime, perhaps, you can insert, in your useful Miscellany, the following problem:

Given the diameter, D Q,* of a circle, the cords A B, C D, with the angles A S B, B S C, and C S D, to find the middle arch, or cord, B C, the position of S, (the points A, S, and D, being in the same straight line with each other,) and the distances A S, S B, S C, and S D. By geometrical construction and by calculation.—I am,

SIR, your's, &c.

D. B.

Glasgow, 29th March, 1824.

* See fig. 2, in our next Number.

On the COURSE *of a* BODY *through a* DENSE MEDIUM, *acted upon by two different forces.*

MR. EDITOR,—In the Twelfth Number of your Magazine, when making your remarks on the solution of the physico-nautical problem there given, you say that "it is obvious that if the velocity be increased, the resistance will also be increased; hence the vessel will not describe the exact diagonal of the parallelogram, but a curve, the nature of which we wish some of our more learned Correspondents would discover;" in this wish I also join, but must confess myself sceptical respecting its practicability.

By the parallelogram of forces, the alternate sides represent the magnitudes of the two forces applied, and the diagonal, the resulting direction of the body acted upon; now, while the velocity is uniform, however much accelerated, the resistance will also be uniform, and the real velocity will be denoted by the given velocity *minus* the resistance; so that in any point of the diagonal course of the vessel, the velocity and resistance being still in the same uniform ratio, there can be no tendency to deviate to one side or other, but must necessarily proceed in a straight line. As to the ratios of resistance to the different velocities of bodies passing through a dense medium, I have as yet seen no satisfactory explanation; but even should it be exactly ascertained, I should presume that the same rule would find the true course of the vessel, and that by simply stating the given velocities, *minus* the resistance, and contructing the diagram, the diagonal would still give the ultimate velocity and course of the vessel propelled.

I trust some of your more able Correspondents will give the subject a little attention, and favour us with a few remarks on the curvilinear course.

I am, SIR,

Your obedt. Servant.

W. K.

Glasgow, 30th March, 1824.

ON THE GALVANIC EXPERIMENT.

Mr. Editor,—In No. XII. of your Magazine, a 'Student of Natural Philosophy,' requests the opinion of some of your learned Correspondents respecting the cause of the inactivity of a galvanic battery which he has constructed. Although I do not pretend to be entitled to that appellation, I shall endeavour to point out the cause of his failure.

In the first place, instead of placing his plates in the cells in the manner he describes, he should have commenced by soldering them in pairs; for, as the disturbance of the electrical equilibrium is proved to depend upon the contact of dissimilar metals, care should be taken that the surface of each plate should be brought into perfect contact. Besides, this precaution is necessary on another account, for if the liquid with which the battery is charged, be allowed to insinuate itself between the joined plates, the zinc is covered with a crust of oxide, and the contact is destroyed. When the plates are thus prepared, they may be placed in the trough, without partitions or connecting wires, except from the end of one trough to the end of the other.

Secondly, as the continual stream of electrical excitement, in the galvanic battery, is caused by the decomposition of the menstrua employed in the charge, it must be evident, that saline bodies will answer much better than water, which exerts but a feeble action upon the metals employed; therefore, your Correspondent should use a solution of some salt, (say common salt,) or, what is still better, a very dilute acid. By making these alterations in his battery, I have no doubt but he will obtain the wished result.

I remain, Sir,
Your's, &c.
W. C.

Kelvin Dock,
24th March, 1824.

CHEMICAL EXPERIMENTS.

EASY MODE OF PROCURING LIGHT.

Mr. Editor,—I beg leave to send you a short account of a beautiful and simple apparatus for procuring light, by the action of hydrogen gas upon spongy platina. It consists simply of a bent glass tube, with one of the limbs double the length of the other. Near the bottom of the shorter limb is placed a piece of zinc, as at A,* to the top of the same limb is fitted a cork, with a small metallic tube and stop-cock directed downwards. About half an inch under the point of the stop-cock, and attached by a wire to the glass tube, is placed a small piece of spongy platina, either in a copper cup, or wrapped in a cage of wire gauze.

In preparing this apparatus for use, the cork (with the bent tube and stop-cock) is to be removed, and the short limb of the glass tube filled with sulphuric acid, previously diluted with four or five times its weight of water, the cork must be firmly fixed to the mouth of the tube with wax or luting, and the stop-cock shut. The diluted acid will now stand at the same height in both limbs of the instrument, but the water being decomposed by the action of the sulphuric acid and zinc, hydrogen gas is produced,

* See fig. 3, in our next Number.

which rises to the top of the shorter limb, and forces its own bulk of the fluid into the longer one. The action continues until all the fluid is forced out of the short limb, which is now filled with hydrogen, and the fluid being removed from the zinc, the action ceases. But, if we now open the stop-cock, the weight of the fluid in the long limb instantly forces the gas from the shorter one, with sufficient force to make the platina against which it is directed *red hot,* and will easily afford a light on applying a sulphur match. The diluted acid being again in contact with the zinc, more hydrogen is formed, and the apparatus is immediately ready for use. Thus we have a constant supply of gas always subjected to pressure, and the platina being fixed at a proper distance from the stop-cock, we can at all times procure a light by simply turning the cock and applying a sulphur match to the wire cage containing the platina. The tube may be fixed into a stand, and, when placed on the mantle-piece, forms an elegant and useful addition to the parlour or bed-room furniture.

I must remark, however, that although I have used this instrument for some weeks, I can very seldom succeed in lighting the hydrogen with it, which may arise from the small quantity of gas contained in the tube, and the very short time it can have to act upon the platina; but it never fails to make the metal hot enough to light a sulphur match. One advantage attending this instrument is, that it is not so liable to be broken as the more complicated apparatus used for the same purpose; and another, that the whole expense will not exceed a very few shillings.—I am, SIR,

Your obedient Servant,

F. J. G.

Glasgow, 30th March, 1824.

RECIPE FOR SEIDLITZ POWDERS.

Take two drams of Rochelle Salts, two scruples of the Super Carbonate of Soda, half a dram of Tartaric Acid; powder the Rochelle Salts and the Soda together, and dissolve them in a tumbler of water: (half-a-pint is a good quantity,) then powder the acid and dissolve it in another tumbler, containing the same quantity of water. Mix the contents of the two tumblers, and drink off the mixture, while it is effervescing. If it disagrees with the stomach, add a little lemon juice or citric acid.

The above quantity of Rochelle Salts is insufficient to prove cathartic; but if this be required, add half an ounce, or an ounce, of the Rochelle Salts to the above quantity of Soda and Acid.

PROBUS.

ON MASTIC CEMENT.

(Read before the Glasgow Philosophical Society, by Mr. ROBERT HART.)

MR. PRESIDENT,—In this Essay, I propose to give a few remarks on the nature and composition of the mastic cement, in use in London and other places, where stone is not easily obtained; and, after enumerating one or two experiments which I made to ascertain its properties, to give a short detail of the compositions of the specimens now exhibited to the Society.

I first ascertained, by analysis, the component parts of the mastic cement with which the Tron Church

Steeple has been lately coated, and found them to be nearly in these proportions; *viz.* 50 parts of sand, 50 of lime, and from 4 to 5 of red lead. I then endeavoured to discover what was the cause of the hardening of this cement, when mixed with oil. This seemed to be owing to the lime which forms a part of it, or to the fine powder which was intended to give it a body; of this indeed there could be no doubt, as the lime is not calcined, but consists only of pounded limestone which could not act upon the oil any more than the sand, or any other powder; and the small quantity of red lead only tends to dry the oil.

From this view of the subject, it occurred to me that a substitute might be obtained at a much cheaper rate than the cement, as the English mastic is 11*l. per cwt.* After a number of experiments which I made, with different materials, I succeeded in forming a few substitutes that seem to harden as well, and from the nature of the materials used, I think they should last as long as the mastic, because they consist both of a coarse putty, composed of sand, for a body, and of oil for a binder.

I uniformly found, when much oil was added, that the composition took a gloss when smoothed on the surface with a trowel; that is, the oil made its appearance on the surface. In this state the composition assumed a skin upon its surface, and remained soft below, as happens in common putty; but I had no doubt that a few weeks of good weather would dry it thoroughly, and when once dried, it would last even longer than when less oil had been used.

The quick drying of the mastic appears to arise from the small quantity of oil used in proportion to the other materials. For since the whole mass is in a manner porous, the sand, &c. being only wet with oil, it is only at the points of contact of the particles of the composition that the oil forms a junction between them; and this small portion is easily dried, the air being partially admitted by the porosity of the cement.

The sand should not be too coarse, otherwise it is easily rubbed off after the surface is broken. Clear fine water-sand, or bruised sand-stone, such as the rubbish of mason's sheds, which is already finely pounded, being passed through a fine sieve, will form a very good cement.

To ascertain whether the lime was really of use in making the cement, or whether the sand was absolutely necessary to the lime, or whether each was not of itself sufficient, the following experiments were made:—

1st, Fine pounded lime passed through a sieve, and mixed with oil only, formed a cement which hardened very well.

2d, Sand used by founders, which commonly contains a portion of iron and clay, was also mixed with oil, and formed a cement which hardened in the same manner.

3d, Pounded sand-stone, and pounded Gibraltar rock, were mixed, in like manner, with oil, and gave similar results.

The Gibraltar rock approached nearest to the colour of the lime used in the mastic, and both it and the pounded sand-stone have hardened very well.

After these, the following experiments with their results were made in succession.

COMPOSITIONS.	NATURE
100 Parts Sandstone, and 10 red lead, ...	very hard.
100 Lime riddlings, and 2½ red lead, ...	rather softer.

COMPOSITIONS.	NATURE.
100 Lime riddlings, 100 sand, and 5 red lead,............	as hard as the London mastic.
100 Gibraltar lime, 100 sand, and 10 red lead,...........	
100 Gibraltar lime, 100 sand, and 5 red lead,...............	hard also.
100 Sand, 50 whiting, and 10 red lead,.	moderately hard.
100 Sand, 40 whiting, 5 of white, and 5 of red lead,.....	
100 Sand, 50 whiting, 4 of white, and 3 of red lead, and 4 yellow ochre,..	near the colour of mastic, and very hard.

These experiments were all made with mixtures brought as near as possible to the same consistence with oil. If too little oil is used, the cement will prove useless, as it is easily rubbed down, from its not being sufficiently bound together, and from its imbibing water, it will soon decay. The colour of the cement was not attended to in some of the experiments, the principal object being to procure a lasting cement. If, however, any particular colour is wanted, which is not the same as that of the composition, the surface may be painted; and if, after painting, the rough appearance of sand-stone is wanted, it may be dusted with sand, which will be an additional protection against the weather.

From the experiments that were made, it appears that oil rendered dry by red lead, or even without it, will form a composition with almost any powder not easily acted upon by the weather; that this composition will answer all the purposes of mastic; that it may be made almost at such a small expense that we may save 10*s.* 6*d.* per cwt; and that, by choosing proper materials, almost any stone may be imitated. Ornaments may be made of these substances at a very cheap rate, and they may be taken from good models often, when we cannot get them cut in stone for want of proper tradesmen; these ornaments may be introduced into recesses where they would be, in a manner, protected from the weather. Such as the bas-relief figures on the front of the Assembly Rooms. They are easily formed by pressing the composition into a mould, laying a flat stone upon it, inverting the whole, and then removing the mould carefully, as a founder does his pattern from the sand. For large figures, the mould should be oiled with a greasy oil before putting in the sand, &c., and the composition allowed to harden before removing it from the mould; by this method, the best impression would be obtained, as it has a tendency to adhere to the mould when wet.

Statues might be made in this mode that would last for many years, if kept in gardens or pleasure grounds, where they are not liable to receive injury. The faces upon the front of the Tontine might be renewed, or, at least, have their decayed noses and ears repaired in this way. But, had two or three coatings of oil been layed upon this building, at a time when the stones were dry, by exposure to a warm sun, it would have kept the face of this edifice quite entire. For these would act on the same principle as that by which this cement is bound together; that is, first, by its giving all the tenacity with which it binds this cement, in addition to that of the stone; and, secondly, by its rendering the stone water-proof. The New Jail stands in need of some protection of this kind, as a number of the stones are already washed away below the surface of the rest, and the under part of all the mouldings are more or less injured. If something of this kind is not soon done, it will, in a short time, be in as bad a condition as the Tontine.

As oil has a tendency to go into a carbonaceous state, by being long

exposed, and thereby losing its tenacity, and becoming a hard brittle crust, easily detached from the surface on which it is laid; and as rosin renders it much more durable, although not so easily dried, I would recommend that pounded rosin should be added to the cement. Part of this rosin will dissolve in the oil, and what is not dissolved will agglutinate the sand more firmly together, thereby rendering the whole more durable. About the proportion of 1 oz. to the pint of oil, is enough, if boiled in it, but rather more will be necessary if mixed in the sand or cement.

In the opening up of new streets, it often happens, that the fronts of old buildings come to be in the line of the new buildings. In cases of this kind, to give them a new appearance, as well as decayed or defaced buildings in general, such compositions as have been described may be used with great advantage. Where stone can be applied, and particularly in places such as Glasgow, where it is so plenty, it should be preferred as most likely to be cheapest at the last. The improvements which are now going on, as well as those which are likely to take place in Glasgow, may render these observations of practical utility to the architect and proprietor.

IMPROVED WINDOW.

Mr. Editor,—I beg leave to send you the description of a window invented by me, since I heard of a man being killed by a fall from *a window* in the Trongate.

By this invention, the window is made to come into the room, so that the glazing, painting, and cleaning, may be performed in the inside of the house; indeed, were this plan generally known and adopted, the many accidents occasioned by working on the outside would be wholly prevented.—I am, Sir,

Your's, &c.

Thos. Johnston.

Glasgow Ink Manufactory, Feb. 18, 1824.

Explanation of the Figure.

The large centre figure is the inside of the window; No. 1 is the upper; No. 2 is the lower sash; 3, 3, 3, 3, 3, 3, are sliding frames, and the white space all around and within, is the frame of the sashes; 4, 4, 4, 4, the window-case; 5, is a shifting piece of the bottom-case, which is kept in by the bolts, 9, 9; 6, 6, 6, 6, are the hinges by which the sashes are hinged to the sliding frames; 7, 7, 7, 7, are the bolts which keep the opposite side of the sashes to the sliding frames; 8, 8, are eyes by which the window is pulled open by a hook, which also opens and shuts the bolts, 7, 7, 7, 7.

The sashes are made to fit into the sliding frames with checks, by which they are rendered weather proof; and the bolts, hinges, and eyes, are sunk in *flush* with the sashes and frames, so as to let them go up and down as usual.

Directions for using windows on this plan.

When the window is to be opened, the bolts of the lower sash are drawn out by the hook, and the window opens inside, the same as a door: when the upper sash is to be opened, push up the lower sash, take out the shifting piece, No. 5, and pull down the upper sash, unbolt and open it. The windows in present use can be altered to this plan, by reducing, and checking the sashes, to admit of the sliding frames, and by cutting out the piece No. 5, in the bottom of the case.

IMPROVEMENTS IN GLASGOW.

We have seen a plan of a great public improvement, which has been submitted to the Lord Provost and Magistrates of this City; who, after inspecting the proposed line, have agreed, in the most liberal manner, to sanction the undertaking. This improvement consists in the opening up of a new Street, to commence immediately below the Markets in King-Street; and, crossing the three Wynds, to extend beyond the Sugar-house in Stockwell-Street, situate below Jackson-Street; and thence, by taking Howard-Street in the line, to form a communication with Jamaica-Street. There is no part of the City which so much requires to be opened up as the line of these Streets, particularly the one from King-Street to Stockwell-Street, which has long been a mere receptacle of filth and contagion. We are happy to learn that an experienced architect has surveyed the ground in question, and has given an opinion that the line is not only free from obstacles, but that it presents peculiar advantages for an undertaking of the kind, both to the public and to those who may take a share in its execution. It is proposed, (under the sanction and authority of the Lord Provost and Magistrates,) to form a Joint Stock Company, to carry this improvement into effect; and, as the sum necessary is not expected to exceed ten or twelve thousand pounds, there can be little doubt of the money being speedily raised, more especially as there is every prospect of its paying the subscribers a handsome return, with little risk. The Corporation of Fleshers are about to open a flagged lane from Saltmarket-Street to King-Street; and, when all these improvements are carried into effect, there will be, what has been long wanted, free communication, by cross streets, from Saltmarket-Street to Jamaica-Street. The leading streets, in the present plan, are intended to be forty feet wide, that is, a few feet wider than King-Street.

ON PUBLIC ERECTIONS.

Mr. Editor,—I observe in an Edinburgh newspaper some description of a new Gas Establishment, which is about to be erected on the line of road from Pitt-Street to Cannon-Mills. The buildings are

to be quadrangular, and constructed in such a manner as to resemble a fortress, having embrasures on the walls, and circular towers at the angles. The laboratory is to be in the centre of the square, and the tall vent for the furnace is to be shaped and finished like a column, after the manner of one which has been lately erected in Glasgow. Whether the idea has been suggested by the handsome structure I have now referred to, I cannot tell; but the example shown by our public-spirited citizen in Queen-Street, is certainly highly worthy of imitation. If it were followed up, as it ought to be, those towering chimney-stalks which ascend in such profuse abundance from our public-works, would, instead of disfiguring the city as at present, tend greatly to ornament and adorn it. We should have Tuscan, Doric, and Corinthian columns, rising in all directions, and lifting their lofty summits to the skies. The effect from Blythswood-Hill and the surrounding heights, would be magnificent. It would be like a city of palaces. We have to regret, indeed, the humble materials of which these pillars must of necessity be composed, but even *these* might be improved by "art and man's device;" and, at all events, a little distance would give enchantment to the view. I am sorry to see so little attention paid in general to the burning of the smoke; but I have no doubt, from the taste and ingenuity of the proprietors, that in this respect, also, the erection in Queen-Street, will hold up an example to the public.

I am,

Mr. Editor,

Your obt. servant,

W.

Glasgow, 2d April, 1824.

FIRE-ESCAPES.

A fire-escape is a machine for escaping from windows when houses are on fire. Various machines to answer this purpose have been invented by different individuals. Much praise is, unquestionably, due to all who devise the means to ameliorate the sufferings of their species, under any calamity; we cannot withhold our warm expressions of gratitude to all who endeavour to promote human good, nor can we sufficiently express our thanks to such as essay to prevent the occurrence of evil.

Thus we are disposed to eulogise those very laudable institutions, denominated *Assurance* or *Insurance* offices,* for saving harmless the sufferers, with respect to pecuniary loss, by the fatal raging, and the frightful mastery of the ignitious element. Should these be entitled to approbation on account of their providential benefits, no less are those ingenious individuals, who apply the purposes of mechanism to the very laudable view of saving life. Numerous have been the devices adopted for this humane purpose. Preference appears to have been given by a modern author,† to a machine invented by John Daniel Maseres, Esq. the description of which has been communicated to the world by B. M. Forster, Esq. published, with some improvements by himself, in the Philosophical Magazine: it is called "The Sling Fire-Escape."

1. It seems it was effected by an iron suspended from a beam, constructed on

* First introduced under the reign of the Emperor Claudius.—*Nicholson.*

† Dr. Rees.

nciple somewhat similar to, and
nating like that destructive instru-
used in ancient warfare, called a
head, and now applied to the more
purpose of slinging goods from
house-doors; but, we understand,
this special difference from the last
oned machine, that the bottom
are turned up to the upright part,
m two close rings, of 4½ inches in
ness of the iron out of which it is
ered, to about half an inch.

There is a strong rope, made of
plaited in a peculiar manner, for
a patent was taken out by Arm-
g, of St. John's Square, Clarken-
of about three-eighths of an inch
meter; this rope, it is said, must
out twice the length of the distance
the window to the ground.

The member, called a regulator, is
long piece of beech-wood, 6½ inches
gth, 3¼ inches broad, about ⅞ of
ch thick, in which there are four
placed for the rope to pass through;
f these is open at the side; there is
notch at the top of this piece of
, and an oblong hole, about ⅞ of
ch from the bottom.

Another appendage is called an up-
elt, which is a stout leathern strap,
4 feet 3 inches long, 1½ inches
, with a buckle to it.

The lower belt is a strap also, of
ame sort as the other; this is for the
se of additional security, in case the
e of the buckle should break by ac-
t.

Another member is called an union
, which is, we understand, so named,
its connecting the regulator to the
parts of the machine. This is
ather, about 1½ feet long, and 1¾
broad; like the others it has a
e to it. It is stained *black*, which
r serves to distinguish it from the
leathern straps.

ne method of putting all those parts
e machine together, is, first to pass
nd of the rope through the holes
e regulator, then through the two
rings in the suspension iron; the
r belt is then to be passed through
ubling of the union strap; after
h the rope is then to be tied to that
and the knot secured by a string
slipping, (which string is to pass
gh two small holes in the leather,)
at about a foot below the rope, is
tied to the lower belt, in like manner; next, the union strap is to be put through the oblong hole in the regulator, and buckled, by which the upper belt and the regulator will be connected; the other end of the rope may be kept wound round a wooden roller, to prevent it from getting entangled.

Persons who purchase these machines should have a strong iron hook, with a spring catch, to fasten to some secure part of the window-frame, or elsewhere; on this hook the suspension iron is to be hung by the upper ring, when any one wishes to descend from a window. The next operation is to step into the lower belt with both feet, and to draw it up sufficiently high, so as to form a kind of swing to sit in: the part of the strap which is through the hole, is to be laid hold of by the left hand, and the buckle, with the right hand, is to be slipped to its proper place, according to the size of the person; the tongue is then to be put into one of the holes, as in buckling common straps. After this is done, the upper belt is to be somewhat loosely buckled round the chest, and then the rope which is in the roller, is to be thrown out of the window to the ground.

Now, all being ready for descending, the person is to get out of the window, grasping tight, with one or both hands, the rope, at some convenient part, taking especial care not to meddle with the suspension iron, until quite out of the window; after which, the rope below the regulator is to be laid hold of with the right hand, and to be let run through the holes, as fast as there may be occasion; for which purpose, if necessary, it may be slipped out of the open hole, it will then have the check of only three holes; if the motion is wanted to be retarded, the rope is to be put into the notch at the upper part of the regulator. When one person has descended, and there is a necessity for a second immediately to follow, the union strap is to be then unbuckled, when the regulator will be separated from the upper belt; the belt may then be very easily drawn up, having the friction of the suspension iron only, and the person above is to put on the belt as before directed, and be let down gradually, partly by the one below, and partly by managing the rope, as the other did; in this case, however, great care must be taken, as the check occasioned by the regulator is gone.

Observations and Cautions.—It is not easy to put down rules for what number of holes the rope must pass through, as this must be varied according to the weight of the person, and other circumstances. It would be well, before the person gets out of the window, to examine, first, (it is, indeed, absolutely necessary such investigation should be made,) whether the suspension iron is on the hook, then, that the buckles are fast, the two knots tied, and that the rope is in the hole of the regulator, which has the opening; great care must be taken that there is not any impediment to the free running of the rope, for which the wall of the house must be examined, and any nails or hooks which may chance to be there, removed; also, iron scrapers, and any thing where the rope is likely to hitch.

Mr. Forster has, in some respects, simplified Mr. Masere's machine, particularly in substituting the ram-head suspension iron, in the place of a more complicated, and, in his opinion, less secure piece of mechanism. It consists of a solid piece of metal (in the latter improved ones) grooved cylinder, round which the rope is coiled two or three times, by which a considerable degree of the friction originally produced, is prevented, as well as the rapid descent which would otherwise happen. The metal cylinder is supported on an iron frame, and suspended by a ring in the upper part of the frame, inclosing a grooved cylinder, and having a metal bar to hold the cheeks together.

Without any intention to deteriorate from the ingenuity of the above described machine, much less to undervalue the judgment of the learned gentleman who has given it a place in his valuable labours; we have seen a machine, more recently invented, which, in our humble judgment, infinitely surpasses Mr. Maseres' invention. And, we submit, it is to be considered superior; because its simplicity is so very evident. And, also, because there are none of those intricate and tedious precautions necessary to be taken, which appear in the former machine to be essential? and, really, at the time of such confusion as is produced by a fire, these necessary precautions cannot be presumed to be attended to. Likewise, because of its superior accommodations.

The machine we now allude to, was
an invention of Mr. Gregory, an
ous practical mechanist, for wh
obtained a patent in the course
year 1818. It, to the best of our
lection, consisted of a strong
frame, about eight or nine feet lon
four feet high, supported upon tw
trees, to which were attached four
iron wheels; upon the top of this
were deposited three ladders, whic
raised so, as for the lower end
second to rest in a groove on the
the first, and fastened together by
iron hinges; and for the third to
like manner, raised to the top
second, well secured, by means
strongest iron work. We regret
the exact mode of the constructi
these joints, is not, at present,
our remembrance; but its general
ciples we perfectly recollect; thes
ders were raised by means of two
one end attached to the uppermos
der, and the other to the beam of a
lass, which had a double handle.
beams of the uppermost ladder, we
pulleys made of metal, a porti
which ropes, beyond the pulle
fastened to a frame of strong wo
iron, of about four or five feet
and three wide, to which frame is
strong netting, and which forms
commodious cradle for the recept
two people, a very lusty person, o
man and child, &c. or for any w
sick, or lame. This cradle is let
with expedition and ease, by me
the windlass, and raised as often
necessary. It also is most conv
for people whose fear might p
their going upon ladders; or for
the state of whose health would no
mit them to trust themselves upon
unaccommodating means as the fir
scribed.

What, in our opinion, also re
this infinitely preferable, is, that
be placed as near to a house as m
necessary, is instantly put in moti
the assistance of two persons; a
fires it generally happens that the
always in populous towns, where fi
most to be dreaded, plenty of peo
assist. The cradle, independent
utility previously mentioned, will,
contain property which no pecu
means can replace, which may be br
down in the custody of the pers
whom it is invaluable. For these
sons, and many others which will

parent, we do not feel the slightest hesitation in giving our decided preference to Mr. Gregory's machine.—*History of Inventions and Discoveries.*

ON MACHINERY FOR CALCULATING AND PRINTING MATHEMATICAL TABLES.

By Charles Babbage, Esq. F. R. S. Lond. & Edin. &c.

The following interesting article would seem to us to have the air of a philosophical romance, were it not brought before the public under the sanction of very high names in science—names which have procured the inventor a handsome sum from government, for the prosecution of his labours, in making them available to the public.

Among the brilliant inventions which have distinguished the present age, the machinery invented by Mr. Babbage for performing intellectual labour, is entitled to a prominent place. Low as that species of mental exertion undoubtedly is, when the mathematician performs the monotonous round of arithmetical calculations, in which neither the power of combination nor of judgment is called into action; yet we were not prepared to see even these humbler functions placed under the survelliance of wheels and pinions; and hence the first intelligence of a calculating machine has been received with as much incredulity by the wise as by the vulgar.

The object which Mr. Babbage had in view, in constructing this new machinery, was to produce printed copies of any mathematical tables, *without the possibility of an error existing in a single copy.* This result he proposed to attain solely by machinery, which, at the same time, made the calculations, and composed, with a proper type, the tables, when computed. At the commencement, of course, of these operations, certain preliminary calculations must be made; and, at intervals, the machinery must be set to these numbers; but, in some cases, when once set, the machine will continue working to the end of the tables.

In these contrivances, there are two distinct parts, viz. *one,* by which the tables are computed, and the *other,* by which they are composed; but as the actual execution of such machinery requires a great expense both of time and money, Mr. Babbage has contented himself with sketches on paper, accompanied by short memoranda, by which his contrivances may be, at any time, more fully developed; and, when any new principles have been introduced, he has examined their actions by models executed on purpose. In order, however, to prove the practicability of these views, he has finished a small engine, by which the calculations are accomplished, and which has actually computed the following table, in which the second differences are constant.

Table computed by Mr. Babbage's Arithmetical Engine, from the Formula $x^2 + x + 41$.

41	131	383	797	1373
43	151	421	853	1447
47	173	461	911	1523
53	197	583	971	1601
61	223	547	1033	1681
71	251	593	1097	1763
83	281	641	1163	1847
97	313	691	1231	1933
113	347	743	1301	2021

The figures, as they are calculated by the machine, are not exhibited to the eye, as in sliding rules, and similar methods, but are actually presented to the eye on two opposite sides of the machine; the number 593, for example, appearing in figures before the person employed in copying. When the machine was engaged in calculating the preceding table, a friend of the inventor undertook to write down the numbers as they appeared. In the earlier numbers, the copyist, in consequence of writing quickly, rather more than kept pace with the engine, but as soon as four figures were required, the machine was, at least, equal in speed to the writer. At another trial, *thirty-two* numbers, of the same table, were calculated in *two minutes and thirty seconds;* and as these contained *eighty-two* figures, the engine produced *thirty-three* every *minute;* another time it produced *forty-four* figures in a minute; and as the machine may be moved uniformly by

a weight, this rate of computation may be maintained for any length of time; and it is probable that few writers are able to copy, with equal speed, for many hours together.

Notwithstanding the defective workmanship in this first machine, its computations are wonderfully accurate; and some very skilful mechanics to whom Mr. Babbage has shown it in confidence, are of opinion that it may be carried to any extent. Its parts, indeed, are few, but frequently repeated; and though it contains many wheels, yet only a few of them move at the same time, so that its simplicity is greater than that of many machines in common and constant use.

There is one circumstance in the construction of this machine, which is of considerable importance in making larger ones, viz. that, though its wheels are numerous, yet by a peculiar contrivance, any error produced by accident, or by a slight inaccuracy in one of them, is corrected as soon as it is transmitted to the next, and in such a manner as effectually to prevent any accumulation of small errors from producing a wrong figure in the calculation.

The machine for composing with types, has not yet been actually constructed; but from several models which Mr. Babbage has made, and from numerous experiments which he has tried, there can be no doubt of its complete success.* When put up, the composing machine will contain about 30,000 types, which are put in their places by children; but the person who attends the engine has a method of ascertaining, in less than half an hour, *if any one individual of this number is misplaced.*

(To be continued.)

* A working model of this part of the machinery has been recently constructed.

LETTERS AND QUERIES.

VERY CHEAP BAROMETERS.

Mr. Editor,—As there has been so much discussion in your Numbers lately on cheap barometers; and as it appears, from a Correspondent in Anderston, that they have not proved satisfactory, I have therefore been bold enough to send you a few remarks on some, which, from long experience, I have found seldom to go wrong; and I have been more inclined to do so, as I find that cheapness is a great consideration.

The barometers to which I call your attention, are the chimneys of every house, and the stalks of every steam-engine; and I am sure, that in a city so large as yours, you will have not a few to boast of. The principle of the mercurial barometer, depends on the density and rarity of the atmosphere; for, in the former case, the mercury rises owing to an increase of pressure on the surface of the mercury in the cup, and in the latter case, falls owing to a diminution of pressure. Now, the principle of the *smoke barometer* is precisely the same; for, when the atmosphere is dense, the rarified smoke, at the head of the chimney, rises into the air, which is the case in dry weather; but when the atmosphere is rare, the smoke descends, which is the case in wet weather. These changes in the atmosphere commonly take place before the change of weather; and, to a nice observer, these changes on the smoke are very sensible.

I intend to make a few more observations, (particularly to find what height of a chimney answers best, &c.) which, if you think will be worth a place in your Magazine, shall be at your service.

Your's, &c.

T. C. G.

Paisley, 26th March, 1824.

P. S.—In No. IV. of your Magazine, a Correspondent states, in an answer to a question on Loch

Ness, that some part of it is so deep that no bottom can be found with the longest line. If J. P. would give me his reasons why no bottom can be found, through the medium of your Magazine, it will much oblige; and, in doing so, he will be giving an answer to a query already proposed in one of your Numbers; the length of the line would be no reason for this, as it could be made of any length.

We shall certainly be obliged to our Correspondent for his additional observations, as we are convinced that our readers could not wish for a less expensive barometer.

POISONED EGGS.

Glasgow, 30th March, 1824.

Mr. Editor,—While you are treating of poisons in your instructive Magazine, the following very interesting case, extracted from the 53d volume of Tilloch's Magazine, may, perhaps, deserve insertion.

Your's,

A Mechanic.

"A small farmer, in the village of Heath, near Wakefield, in Yorkshire, lately had several of his hens die, owing, as has since appeared, to a neighbour, into whose garden they had been in the habit of straying, having strewed barley impregnated, or mixed with arsenic, in order to destroy them. One of these poisoned hens laid an egg, about an hour before she died, which the farmer, unknowingly, ate, fried with a collop, (being then in perfect health,) but he was soon after seized with violent pains and sickness. An experienced medical man, who was called in two hours afterwards, instantly pronounced, from the symptoms, that poison had been taken, and immediately administered an emetic and castor oil, by which the patient's life was saved, but he continued ill, and, without doubt, it is said, he would have died if medical aid had not been called in. This ought to operate as a caution against this not uncommon, yet dangerous mode of ridding one's self of trespass from our neighbour's poultry. It has excited the surprise of many that the egg could become so strongly infected with the arsenic before the hen was killed by it. On the discovery of the cause of the farmer's hen's dying, his wife cut open the crops of two of those which lately had sickened, and after carefully emptying the crops of all the barley and other matters, and washing them out, sewed them up again, and, strange to say, they survive, and seem likely to recover.

RED INK.

Sir,—As 'A Constant Reader' wishes to know the best way of making red ink, I beg to inform him, that the most brilliant and permanent red ink which it is possible to make, is as follows:—

Take a small quantity of the best carmine, (the dearest is the cheapest,) about the size of a pea, and put it into a small phial, with a little spirit of hartshorn, to dissolve it; when dissolved, put as much pure water in it as will give it the shade wanted; keep the cork out of the phial for some time, to let the spirit of the hartshorn evaporate; when it is ready for use. I have used it many years, and find that it never changes colour. Bad carmine should not be used, because it has a sediment of vermillion, and cannot be dissolved, which renders it unfit to be used in a pen.

I am, Sir,

Your's,

N. Dismorr.

Barrowfield Dye-Works, 26th March, 1824.

ON SETTING POTATOES.

Mr. Editor,—The following singular mode of setting potatoes, I once witnessed on the continent, may, perhaps, lead to some improvements in the mode of planting, or setting them here:—After the ground was prepared, a boy dug out a spadeful of earth, about 18 inches separate, leaving a hole, which was filled up with a mixture of light earth and manure; a hole was then made with a dibble, and the eye of the potatoe dropped in; then manure, in a liquid state, was poured on, and the rake applied to the surface. The eye of the potatoe was scooped out, the size of a nut, by an instrument for the purpose. In this way, no waste was made of the potatoe, and it was expected to yield half as much more by this mode, than by the common

mode of setting them. Whether this climate and soil would yield such a crop, can only be ascertained by a trial of a small piece of ground for that purpose.

I am, Sir,
Your's,
D. R.

Barrowfield Dye-Works.

QUERIES.

1. J. K. wishes to be informed, upon philosophical principles, why a boiling kettle can be taken from a strong fire, and rested upon the hand without burning it?

2. Is there any method of making a liquid jet black colour, to answer the purpose of drawing, in water colours, and to appear opaque or otherwise—and what is the process of making it?

D. R.

List of PATENTS, *continued from page* 208.

To John Jones, of Leeds, in the County of York, late of Gloucester, Brush Manufacturer, for his invention of certain improvements in machinery, and instruments for dressing and cleansing Woollen, Cotton, Linen, Silk, and other Cloths, or Fabrics; and which improvements are also applicable to the dressing and cleansing of machinery of various descriptions, and other articles or substances.—27th January. Six months.

To Sir William Congreve, of Cecil-Street, Strand, County of Middlesex, Baronet, for his invention of an improved method of Stamping.—7th Feb. Six months.

To the Rev. Moses Isaacs, of Houndsditch, in the City of London, for his invention of certain improvements in the construction of machinery, which, when kept in motion by any suitable power or weight, is applicable to obviate concussion, by means of preventing counteraction, and by which the friction is converted into an useful power for propelling Carriages on Land, Vessels on Water, and giving motion to other machinery.—19th Feb. Six months.

(To be continued.)

NOTICES TO CORRESPONDENTS.

A. B.'s (Paisley) solution to the geometrical problem is erroneous.—W. T. Carron Shore, has constructed the same problem accurately, we would thank him for the solution.

BANDANA CONTROVERSY.—With reference to the statements of Mr. Campbell and Mr. Harvey, which have been annexed to our Magazine, we think proper to observe, that while Mr. Rodger, on the one hand, claims to have performed the discharging process in question, in the month of July 1802, Mr. Campbell states, on the other hand, that, for a number of years afterwards, Mr. Rodger, though in the employment of Messrs. Monteith & Co., was not allowed so much as to see the apparatus employed by these gentlemen; and farther, that while Mr. Campbell denies our statement, that Messrs. Monteith & Co. abandoned their attempts at the discharging process, from want, we said, of attaining a proper process, Mr. Harvey, whose sources of information are certainly equally good, admits that they did abandon the process, but for some good reason which he thinks it unnecessary to state. With inconsistencies so gross, among the opponents of Mr. Millar's claims, the writer of this article thinks it quite unnecessary to enter into the defence of these claims; for which, however, by statements (of course separate from the Magazine) he is quite prepared. We may add, that even supposing (what we have not questioned) that Mr. Rodger and others did make attempts towards the process in question, it would remain to be proved, that their attempts succeeded "in accomplishing a tolerable manufacturing process, or in producing a marketable manufacture." If this was accomplished, it may be easily proved; for, in that case, Messrs. Monteith & Co., who, by all accounts, had set their heart on the process, must have manufactured a considerable quantity, before (for example) the year 1804. In proof of the *quantity* manufactured, let Mr. Rodger, who may easily procure it, produce an authenticated Excise extract of the duty paid. If this be not produced, we shall of course presume that it cannot be produced. But we shall be happy to see such an extract, with whatever face it may come, as our only wish is, that justice should be done to all parties.

We omitted to state in our last, that the notes on the article Caloric were taken from Dr. Ure's Dictionary.

Communications from intelligent Mechanics will be very acceptable, in whatever style they may be written, if they contain a full account of the invention or improvement which is the subject of their notice.

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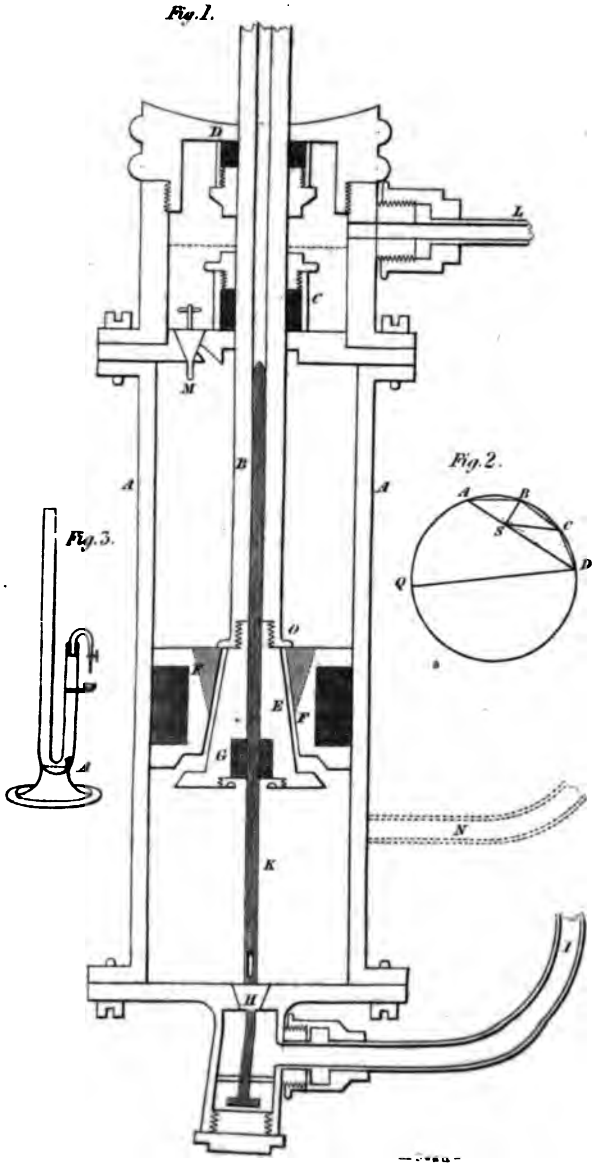
J. CURLL, PRINTER.

THE GLASGOW
MECHANICS' MAGAZINE.

"Who laid foundations for the spacious earth?
Who, on the surface, did extend the line,
Its form determine, and its bulk confine?"—*Young.*

No. XV. *Saturday,* 10*th April,* 1824. Price 3*d.*

IMPROVED AIR-PUMP.



IMPROVEMENT IN THE AIR-PUMP.

Mr. Editor,—The following description, of the most improved Air-Pump, may be interesting to the inquiring mind, as there are many important experiments connected with the Science of Pneumatics. Indeed, without the aid of a good air-pump, the experimenter will find his attempts very unsatisfactory, as the common air-pump produces a very partial vacuum, in which no important experiment can be performed with success.

I have tried the effects of the following different kinds of pumps, and I find that the common bladder-valve-pump exhausts only 30 times; Cuthbertson's, 600 times; Cuthbertson's, as fitted up by Miller and Adie, Edinburgh, which is the best, being the one which Dr. Ure exhibits to his Class, rarifies no less than 1500 times; that is, the mercury, in the barometer attached to the pump, stands only $\frac{1}{1500}$ part lower than the detached barometer.

Description of this Air-Pump.

Fig. 1st. A, the barrel of the pump. B, the piston rod, which moves through the stuffing boxes, C, D. At the bottom of the piston, is screwed the conical valve, E, which is ground tight into the piston, F, F. When the piston rod, B, E, descends, the shoulder, O, pushes the part, F, down before it, and the air under it, freely passes through the opening, F, F, and escapes at two little slits at the top of the conical hole; the slits are shown by the dotted lines at F, F, and are intended to prevent the air-pump being stopped by the shoulder, O. As the piston is descending, the valve, E, F, is open, and the valve, H, is shut, by the friction of the rod, K, passing through a small stuffing in the centre of the piston, at G. But as the piston begins to ascend, the part E, moves before the part F, and shuts the opening, lifting all the air above, and discharging it at the valve, M, (which is surrounded by oil,) where it escapes at the pipe, L. This pipe also answers the part of a condenser, by screwing the vessel, in which the air is to be condensed, on to the end of the pipe.

Now, where the piston ascends, the valve, H, is open, (by the friction of the rod, K, in the stuffing, G,) and the air rushes from the receiver by the pipe, I. There is a little slit above the valve, H, which allows the rod, K, to have a little play, so that the one valve may be shut before the other opens.

This pump might be greatly simplified, in the following manner:—Suppose the piston to be made solid, and having no valve at the bottom of the barrel; but let the pipe from the receiver be made to enter in the manner shown by the dotted lines at N. Where the piston descends, there will be a vacuum produced above; but as it passes the hole N, the air will rush in from the receiver, and restore the equillibrium; and, as it ascends, will discharge the air, as on the former plan. It is requisite, however, that there should be a small groove from the hole to the bottom of the barrel, to allow the air to pass the piston, that it may reach completely to the bottom.

I have no doubt that on this plan a more perfect vacuum would be formed than on the former, and with a vast deal less labour in the fitting up.

I am, Sir,

Your's, &c.

J. C.

P. S. The simplicity of this plan

lers it a matter of wonder, that ias never been put in practice, the same principle is employed the air-gun condenser, from ch the above idea was taken.

derson's Institution, ow, 17th March, 1824.

'he plan proposed by our in- ious Correspondent was actually in practice, in the construction small air-pump and condenser, nted by Dr. Ure, and made rding to his directions by Mr. ies M'Innes, working me- ic, to Anderson's Institution, about eighteen years ago. Dr. Ure, to whom we are indebted for these particulars, also favoured us with a sight of the instrument, which was beautifully simple, and perfectly adapted to the purpose. Our Correspondent, however, has the merit of re-discovering the principle, and applying it to the air-pump in its present most improved state.

Fig. 2, refers to the second, and Fig. 3, to the fourth article, in our last Number. Fig. 4. See No. XVII.

PHYSICO-NAUTICAL PROBLEM SOLVED.

A boat in a current, which ild move her at the rate of six s an hour," &c.—Glasgow Me- ics' Magazine, page 180.

By Construction.

Draw the indefinite right line, A B, 4.) to represent the meridian; off at an angle of 22° 30′, (which e S. S. E. rhumb,) the line C D 6. At right angles with A B w the East rhumb line, C G = 30. ke D E = 8. Complete the mboid C F E D, then will the le A C F be the course the boat must steer; the line C E the distance sailed in one hour, and as many times as C G measures C E, so many hours is the time of performing the voyage.

By Calculation.

The angle E C D is 90° — 22° 30′ = 67° 30′ = angle C E F. In the triangle C E F there are therefore given, C F = 8, E F = 6, and the angle C E F = 67° 30′, to find the line C E, and the angle E C F. Hence, by Logarithms, we have

As C F	= 8	= 0.903090
Is to E F	= 6	= 0.778151
So is Sine C E F	= 67° 30′	= 9.965615
To Sine E C F	= 43° 51′ 38″	= 9.840676

Hence the angle A C F 90° — 43° 51′ 38″ = N. 46° 8′ 22″ E. is course. And 180° — $\overline{67^\circ\ 30' + 43^\circ\ 51'\ 38''}$ = 68° 38′ 22″ = the le C F E. Hence, by Logarithms, we have

As Sine C E F	= 67° 30′	= 9.965615
Is to Sine C F E	= 68° 38′ 22″	= 9.969093
So is C F	= 8	= 0.903090
To C E	= 8.0643	= 0.906568
Now, miles 30		= 1.477121
Therefore, hours 3.72		= 0.570553

Or $\frac{30}{8.0643} = 3.72 =$ 3h. 43m. 12s. the time in which the vessel will complete her voyage.

So that the boat, to gain her port, must be rowed for about three hours and three quarters, in nearly a North-East direction.

I send you this solution, merely to create an opportunity of requesting a Geometrical and Arithmetical solution of the problem proposed in your Magazine, page 78, "to divide a given circle into two equal parts, by the periphery of another circle, whose centre is in the circumference of the given circle."

If this is done according to the method proposed, and the solution given in your Magazine, it will oblige some of your readers, as well as BETA.

We have received an approximate solution of the problem mentioned by our Correspondent, but it does not just please us; we therefore join in his wish for a proper solution from some of our mathematical Correspondents.

The solution of J. D. C. to the problem solved above, was erroneous, but it evidently arose from inattention, and not from want of skill. His remarks upon our observations respecting the course of a body through a dense medium, are superseded by those of K. in our last number. As both of them seem to have misunderstood the observations to which we refer, we consider it necessary to give them a farther explanation. Were the velocity and the resistance both uniform, as K. supposes, there can be no doubt that the vessel, on a level surface, would describe the exact diagonal of the parallelogram. This would not be the case, however, if the velocity were "uniformly accelerated;" neither would it be the case if the velocity were "uniformly retarded," as it is by the "increased resistance" of the water. If the resistance of the water be in the ratio of the squares of the velocities, or nearly so, for the one force, and in a higher ratio, suppose, for example, as the cubes of the velocities, for the other force; it is evident, that in this case the body acted upon by these two forces, would describe a curve, which it would not be very difficult to discover. We do not say that these are actually the ratios of the resistances, but if the ratios are different for different velocities, the course will be more or less curvilinear in proportion as the ratios of the resistances differ from each other; and we have merely made the above supposition to enable our Correspondents to satisfy themselves as to the truth of our position; which, we believe, they will no longer doubt, after this illustration.

ON MATHEMATICAL STUDIES.

MR. EDITOR,—I observe, with pleasure, a generous and wise disposition adopted by the public to inspire into the Glasgow youth a portion of mechanical knowledge, and, in more ways than one, I am confident it will be productive of the best effects on the minds of the rising generation. But it is not merely practical mechanics that will produce these effects; for, by adding to them a scientific knowledge thereof, founded as it is on the principles of mathematical investi-

gation, a mode of reasoning is acquired, by which the human mind is elevated to a degree beyond what is attainable by any other studies. I would therefore advise the introduction of algebra and geometry into the schools of arts and sciences for which this city is now so famous; a small beginning would be sufficient to rouse the latent powers of genius, and a competition at solving problems and publishing the answers, would stimulate to exertions that would operate in raising a generation of thinking rational beings that would be ornamental to society, and an honour to the place and age in which they live.

The following question might engage the attention of those who have arrived at some proficiency in these studies, and as such may call forth to the field gentlemen of talents worthy of imitation. I might point out authors, the study of whose works would raise to eminence those who would condescend to seek it; but the masters may do this to better purpose than I can, so I proceed to the question:

If there are three given ports, denominated B, C, and H, and from each of the two first, a steam-boat sails at the same time, in different right lines of known direction, and that from B sails 10 miles in the hour, how fast must the others sail, so that they may always be seen from H at the same angular distance; and should they both tack and sail towards H, that they may both arrive at H at the same time?

Perhaps this question may appear, in some respects, paradoxical; it admits, however, of a simple geometrical solution.

J. F.

Glasgow, April 2, 1824.

Our Correspondent will oblige us by fulfilling his promise.

We have received two very pretty algebraic solutions to the geometrical problem proposed at p. 168, No. XI. The one is by the proposer, and the other by A. B., Laurieston; we defer giving these solutions till our Musselburgh Correspondent transmits his easy solution of the remainder of the problem according to his elegant construction.

ON CALORIC AND THERMOMETERS.

[Continued from page 202.]

STRICTLY speaking, all bodies could be employed in the construction of thermometers, since all, as we shall see, are sensible to the variations of heat; but to render this instrument exact and commodious, a choice must be made of the most proper for this purpose. If we employ a solid body, such as a bar of metal, its dilatations and constructions will be too small to be easily observable. If we wish to perceive them, we must enlarge them by pinions and levers, which renders their observation very minute, and often inaccurate. If, on the contrary, we employ, in the construction of our thermometer, an æriform substance, such as the air, or any other gas, the dilatations and contractions will be so considerable, that it will become very incommodious to measure them, when the variations of heat are very extensive. The variations of the volume of liquids, being greater than that of solid bodies, and less than that of the gases, present a mean limit, exempt from these opposite inconveniences, and, consequently, we are led to seek our thermometer in this intermediate class of bodies.

There is, however, one among these, which its physical and chemical qualities render eminently suited for this use; it is called *mercury*, or quicksilver, because, in reality, it resembles silver rendered fluid by heat. Mercury supports, before it boils and is reduced to vapour, more heat than all other fluids, except certain oils; and it can also be exposed, without freezing, to degrees of cold which render all other liquids solid, except certain spirituous liquors, as the spirit of wine, or ether. Besides, mercury has the advantage of being more sensible to the action of heat, than every other liquid; and, in short, the variations of its volume, in the extent of the phenomena which are most commonly observed, are, as we shall see afterwards, perfectly regular and proportional to those which solids and gases experience in similar circumstances. All these properties induce us to employ mercury in the construction of thermometers, in preference to all other bodies.

But that all mercurial thermometers may have a similar progress, and be comparable with one another in every country, it is necessary that the substance employed be constantly the same, and have constantly the same properties. We can only arrive at this, by employing mercury in a state of the greatest purity.

Pure mercury is a true liquid metal, which weighs about 13½ times as much as water of equal volume. It is almost never found in this state of purity, as an article of commerce; it holds commonly in solution, some parts of silver, lead, tin, or copper, metals with which it easily combines. To purify it, we must first free it from earth, stones, and other impurities, which are generally found mixed with it. For this purpose, it is sufficient to inclose it in a bag of chamois skin, and to squeeze it tightly between the fingers. The mercury being pressed escapes through the imperceptible pores of the skin, like a sieve, and falls in a fine silver shower, leaving in this operation every thing that was only mixed, and not combined with its substance.

To separate, however, the metals which can be combined with it, we take advantage of the circumstance, that metals are scarcely reducible to vapour by the greatest heats, while mercury boils and is reduced to vapour, by a degree of heat which is not very considerable. This mixture of metals is heated in close vessels, so disposed as to condense by cooling the vapours of which it is formed, and to collect the liquid which results from them. The heat volatilises the mercury, without reducing to vapour the metals which were combined with it; a separation is thus effected, the metals remain fixed at the bottom of the apparatus, and the pure mercury is found in the cooler.

When this process is applied to small quantities, such as are commonly required in chemical and physical experiments; the impure mercury is placed in a small glass or porcelain retort, and the vapours are received in a glass ball which communicates with the retort by means of a glass tube which is called the connecting tube. This tube is luted* to the neck of the retort at one end, to that of the ball at the other, and the apparatus is thus completely closed up. Under the retort a charcoal fire is

* In chemistry, any clammy composition which is employed to shut the openings of apparatus, is called a *lute*. There are different kinds of it appropriated to the different circumstances of heat, cold, or humidity, which the apparatus is destined to undergo.

lighted up, at first very weak, but which is gradually increased in strength; and, on the other hand, the ball is plunged in cold water, or in pounded ice, to condense, by cooling, the vapours which are formed. The connecting tube is necessary to separate the retort which is heated, from the ball which is kept cool. It is necessary that this be made of glass or porcelain, substances which transmit heat with difficulty; and, besides, it is proper to incline its direction in passing from the retort to the ball, that the vapours which are condensed may cool more easily, without falling back into the retort, where they would be again changed into vapour.

When the mercury has been thus purified, it must be inclosed in an apparatus which makes its dilatations and contractions sensible, and which allows them to be easily observed. This leads us directly to the construction of the thermometer.

(To be Continued.)

GEODESIC OPERATIONS.

THE determination of the true figure of the earth is a problem which involves little difficulty when we take a general view of the subject; but if we attempt to solve it with the strictest precision, it requires the highest resources of analysis. Hence though the sphericity of the earth is a fact that has been long known, yet the efforts of the ablest mathematicians in Europe, have scarcely succeeded in ascertaining and establishing beyond all controversy, its actual curvature, or deviation from the true spherical form.

The common and most convincing arguments for the spherical figure of the earth, we formerly adduced; but this fact is confirmed by other proofs of a more refined, but equally satisfactory nature. The spherical excess of terrestrial triangles is one which could only be obtained from very extensive geodesic measurements, and such only as were conducted by means of instruments of the most accurate and delicate graduation. If any part of the earth's surface had been a perfect plane, it is evident that the three angles of a triangle described upon it, would amount *exactly* to two right angles, (Euc. I. 32.;) but if it be spherical, it can be demonstrated that the amount of these angles must always *exceed* two right angles by an assignable quantity, and one which implies a certain relation between the whole surface of the sphere, and that of the triangle described upon it. The difference, which is denominated the spherical excess, may, in the cases of small triangles, be too minute to be detected by the best instruments; but no extensive geographical survey can be carried on, with any degree of accuracy, without affording the most convincing proofs of its reality.

When we take all these facts and appearances into consideration, we are warranted to infer from actual observation, that the earth is a detached body, floating in the regions of space, and possessing a figure which approaches to that of a sphere or globe. The true form and magnitude of this stupendous mass can only be ascertained by geometrical calculations, founded on the measurement of lines on its surface, or the investigation of some other physical phenomena, which indicate their relations to the body on which they take place.

When we confine our observations to a small portion of the globe, the irregularities which everywhere

exist on its surface, might seem to render it impossible to detect its real curvature; but a more extensive view of the surface soon convinces us, that these irregularities, great as they appear to be, are very insignificant in comparison to the magnitude of the globe. Indeed, the figure of the earth differs but little from the general form it would possess, were the whole of the dry land submersed under the waters of the ocean. Most of the large continents are intersected by inland seas and navigable rivers, which penetrate many hundreds of miles into the interior, and approach so near to their most elevated regions, that none of these elevations can be said to be far removed from the borders of the ocean. The moderate velocity with which rivers in general descend from these lofty eminences, is sufficient to prove that the inclination of their beds is inconsiderable, and, indeed, in no instance, do they flow from a greater height than five miles above the level of the sea. Hence the surface of the ocean, which covers more than two-thirds of the surface of the earth, may be considered as indicating its general figure.

The nature of this figure, or at least its curvature at various points, may be determined from the relative position of lines cutting the tangents at these points at right angles. For, since the waters of the ocean, in a state of rest, assume, by the influence of gravity, such a form that a tangent at any point of their surface is always at right angles to the direction of a plumet-line, it is evident that a comparison of the relative inclination of the vertical lines, at different points on the surface of the earth, will point out the curvilinear direction at these places. If we assume, then, on the same meridian, a number of points, at measured intervals, and determine the angles which the several vertical lines form with each other at these points, the true figure of the earth will be ascertained with precision. If, at equal distances on the surface of the earth, the vertical lines were always found to make equal angles with each other, we should strictly infer that the earth was an exact sphere; but if any deviation from this equality was observed at different points, we should then infer that the curvature belonged to some other solid, whose convexity was always greatest, when the convergency of the vertical lines was greatest. The determination of the true figure of the earth, therefore, depends upon the measurement of two quantities: 1st, The inclination of the vertical lines at two different points on the earth's surface; and 2d, The length of the intercepted arch in reference to the curvature which the ocean would take, if it flowed freely between the two stations. The difference of latitude between two places, or the difference of their zenith distances, from the elevated pole, affording an easy mode of determining the inclination of two vertical lines at these places, we have only to choose two stations situated under the same meridian, and then to determine the distance between them, either by actual admeasurement, or by triangulation.

As the difference of latitude may be ascertained without the zenith distances, by taking the difference of the meridian altitudes of any fixed star, at the two places, it would be easy to determine the proportion of the included arch on the earth's surface to the whole curvature, provided the nature of that curvature was known. We propose the following problem to our young Correspondents, founded on the supposition that the earth is a perfect sphere:

Given the distance between two

places on the surface of the earth, under the same meridian, 75 miles, and the meridian altitude of a fixed star at the one place, 47° 12′, and at the other, 46° 7′; it is required to determine the length of a degree on the surface of the globe, and also its circumference and diameter?

(To be continued.)

VARIOUS COMMUNICATIONS

NEW LONDON ROAD.

Mr. Editor,—While observing the progress of demolition at the Cross, and considering the effect of the design given in one of your early Numbers, I am persuaded, that, however magnificent such a plan might be in itself, it would not harmonise with the rest of the buildings, so as to form one grand whole at the Cross. That narrow wedge-like front on the North side of the new opening, would be ever felt as an incumbrance, and would give an irregular and confused appearance to the whole.

An improvement on the plan occurred to me, which, I am convinced, would have by far the best effect; it is to take the corner of the Steeple as a centre, and describe part of a circle from the Gallowgate to the Saltmarket, which would form nearly a quadrant, and which would give a unity and grand effect to the plan, not otherwise attainable. The new Street might then go off at any part of the curve, and in any direction, without hurting the effect produced, by thus throwing the several vacant spaces into one regular and ample whole; while the principal object (the Steeple) would be seen to the best advantage from every part. The area might also be decorated with the Statue of King William.

This plan, besides, would not require the sacrifice of more property than the original one; because what was taken from one side would be added to the other; one land in the Gallowgate might perhaps interfere, but that would be a trifling consideration in the execution of such an extensive improvement.

G. M.

Glasgow, 2d April, 1824.

TO HARDEN PARIS PLASTER.

Kenmuir, 1st April, 1824.

Mr. Editor,—As the following may not be generally known, your giving it a place in your valuable Journal, will oblige

Dr. Stucco.

Paris plaster casts may be made as hard as marble, and to have the same semi-transparent appearance, by washing them over, two or three times, with a solution of about eight ounces of alum in a quart of water.

When the whole mass is wanted hard, the solution may be employed to mix up the stucco.

The surface of those plaster busts that are not hardened by either of these modes, may be polished by coating them over with equal parts of spermaceti and white soap dissolved in a little warm water. When nearly dry, they may be polished with a piece of soft linen rag.

SOUNDING LINE.

Mr. Editor,—In answer to T. C. G. who, in your Fourteenth Number, requests to know "Why no bottom can be found in Loch Ness with the longest line?" it may be said, that in using a sounding line, such, for instance, as that called by sailors the deep-sea lead, the weight is considerable; and when the line itself is very long, it will become so

heavy as to break, even by its own weight, so that the length of the line is limited to what it can bear. There can be no proof, in very deep water, that the lead has been at the bottom, unless the grease usually attached to its lower end can bring up shells, sand, ooze, or mud, or show other evident marks that it has touched the bottom. The soundings in Loch Ness were made by order of Mr. Telford, Civil Engineer, when it was in contemplation to cut a towing path out of the solid and perpendicular rock on the north side of the Loch, from Fort Augustus to the Fall of Fyers, and when the extraordinary depth of Loch Ness was correctly ascertained by a sea-faring person well skilled in these matters, and selected for that purpose.

J. P.

Glasgow, 5th April, 1824.

KETTLE QUERY.

Mr. Editor,—In this day's No. of your Magazine, a Correspondent, J. C. wishes to be informed, upon philosophical principles, "Why a boiling kettle can be taken off a fire and placed upon the hand, without burning it?" While replying to this query, I may remark, that it is of no consequence how strong the fire is, as it can be raised but little above the boiling point of the liquid contained within the kettle. The reason is simply this—a quantity of soot gathers upon the bottom, in consequence of the smoke of the fire, and soot being amongst the worst conductors of heat with which we are acquainted, the heat is prevented from passing through from the vessel to the hand. This may be proved by taking a clear kettle and boiling it over a charcoal fire, or spirit lamp, and then trying its effects upon the hand; for my part I have neither tried the one nor the other. The elucidation of this question must suggest, to those whose business it is to boil kettles, a piece of economy, not generally attended to, namely, to keep their boiling utensils as clean as possible; for as the soot prevents the heat from passing (in part) the one way, it must, necessarily, prevent it (in part) from passing the other way. A saving of both time and fuel would be the consequence of attention to this fact.

I am, Mr. Editor,
Your's,

T.

Paisley, 3d April, 1824.

MR. KIDD'S SHIP.

A Correspondent suggests that this wonderful specimen of human ingenuity, (described in No. XI.) should be purchased by the members of the Glasgow Mechanics' Institution, and suspended as an ornament in the Hall. He states that the sum of five pence from each member would more than pay it, and render a service to a very deserving individual.

MISCELLANIES.

From the following interesting and useful extracts from the Journal of Science, it would appear that Iron Wire Bridges may be employed with great safety and little expense, circumstances which would render them very useful in many parts of our own country, especially among the Highland glens, where nothing but rotten planks, or branches of trees, are often thrown across deep linns, great ravines, and rapid streams, to the imminent danger of even the most cautious passenger.

Experiment on the tenacity of Iron Wire, by Colonel Dufour.

The extreme economy and facility of construction of wire bridges, are circumstances which cannot but tend to introduce them into very general use: hence a knowledge of the strength of iron wire, as generally prepared by the manufacturers, and the circumstances which have an influence over it, cannot but possess great interest. The following experiments by M. Dufour, being made with a practical view, are, therefore, very valuable, and have already assisted in furnishing data for the construction of two wire bridges across the fortification ditch of Geneva.

The object of the experiments was to determine the absolute strength of wires of different diameters; their elongation when sustaining a given weight; the effects of a sudden concussion; the influence of annealing at a red heat, and the effect of a fold, or return, or junc-

tion of the wire, in determining rupture when in these circumstances.

Four kinds of iron wire were chosen, having the respective diameters of 1, 2, 3, and 4 millimetres nearly. Six experiments on the finest wire, of which the diameter was 0.85, mm. (0.033 of an inch,) proved that the strength was independent of the length; that the mean absolute force of such a wire was 106 lb. avoirdupois, the extremes being 103.7 and 120; and that when annealed, it sustained only 46.3 lb. Ten experiments on the second wire diameter 1.9 mm. or 0.748 of an inch, gave 432.5 lb. as the mean weight it could sustain, the extremes being 397 and 457; from which it would appear, that the first wire had a seventh more of strength in proportion to its diameter than the second. The second wire, when annealed, sustained only 223 lbs., which is to its strength when unannealed, as 100 to 194. The third wire, about .118 of an inch in diameter, sustained, as the mean of six experiments, 843 lb.: when annealed, its strength was to that of the unannealed wire, as 100 to 195. The fourth wire, of a diameter of .145 of an inch, supported 1713 lb. when unannealed, and 889 lb. when annealed, the ratio in the two states being as 100 to 192.

From these experiments, Colonel Dufour concludes, that iron wires, from 1 to 4 millimetres in diameter, support at least 132 lb. for each square millimetre of their section. But, according to known experiments on forged bars of iron, it has been ascertained, that those which are not more than 6 mm. square, do not support more than from 88 to 100 lb. per square millimetre, and those which are larger, only from 55 to 66 lb., a circumstance which sufficiently proves the advantage of employing iron drawn into wires, rather than forged into bars, when the question relates to its tenacity.

The second object of the experiments was, to ascertain the elongation of a wire when submitted to a weight, less than that sufficient to break it. The elongation due to the mere rectification of the sinuosities and curves in the wire itself, was found to be $\frac{45}{1000}$ of the original length, when a bundle of twelve wires of the second kind before referred to and 30 feet long, was charged with a weight of 6621 lb. Another kind of elongation immediately precedes the rupture, and is due to a slight diminution of the diameter. It may be perceived when the wire is charged with two-thirds of the weight it is capable of supporting; and varies between 35 and 57 ten-thousandths of the length. When the wire is annealed, the elongation is very considerable, and about thirteen-hundredths of the total length in all the wires tried.

The influence of folds, returns, &c., on the tenacity of the wire was of great importance, considering the object of the experiments: the following are some of the practical results obtained. When a wire is passed round a ring or cylinder, so as to return parallel to itself, and bear a force applied to the two extremities nearly double that supported by the single wire, it requires that the diameter of the cylinder round which it passes should be at least $1\frac{1}{2}$ inches. In proportion as the diameter is smaller, or the curvature of the wire greater, its tenacity diminishes, and the wire will constantly break at that place. One or more entire revolutions of the wire on the same cylinder must be avoided, because the friction resulting from such an arrangement, opposes the equality of stress which is required upon each of the several wires constituting a bundle.

After many experiments on the different means of joining wires together, experience pointed out, as the most efficient, one which would not have been indicated by theory. The method was to lay the ends side by side, one over the other, and bind them round for the space of at least $1\frac{3}{4}$ of an inch, by a smaller annealed iron wire. Such a junction always resisted the proofs applied, the wires constantly giving way at some other place.

The preceding experiments were made with weights gradually accumulating, and unaccompanied by any sudden impulse or momentum, but as in their application to the construction of bridges, effects of the latter kind would be continually occurring, further experiments were made of this nature. The wires were, therefore, charged with about half the entire weight they were able to support, and then other weights dropped from different heights into the box containing the previous charge. The latter force was always estimated by its momentum, and experiment proved that the second wire, for instance, charged with half the weight it was just able to

bear, could sustain, without risk, a quantity of momentum, equivalent to 3000, the weight being given in killograms (2,207 lbs.) and the velocity by the centemetres traversed in a second.

Suspension Bridge of Iron Wire at Geneva.

THE preceding researches have been applied with the greatest success, in the construction of two bridges across the dry ditches of the fortifications of Geneva. The first of these ditches is 33 feet deep and 108 feet wide at the site of the bridge; the second is 22 feet deep and 77 feet wide; they are separated by what is called the countergard, which is about 70 feet wide, and the top of which is level with the surrounding soil. A stone building is erected on the city edge of the first ditch, which serves as a point of attachment for the wires, as a gate to the city, and also as a station for the persons who have charge of the bridge; a piece of masonry is erected on the countergard, as a point of support for both bridges; and a third erection of a similar kind, serves as an outer gate, and for a support to the end of the outer bridge. The wire used is of the kind called No. 14 in commerce, very nearly of the diameter of the second sort referred to in the preceding experiments; it is made up into lengths or bundles, each containing 100 wires, and there are three such collections on each side of the bridge. As the line of suspension proceeds uninterruptedly across both ditches and the intervening bank, the length was found too great for one bundle; they were therefore made in shorter lengths, terminating at each end with a ring, and were connected by placing these rings side by side, and passing a strong iron bolt through them. Each single wire was first stretched by a weight of 220lbs., then made up into the bundles of 100 each, which were united by iron ties at successive intervals, and the whole rolled round with iron wire, which gives to them the appearance of cords. The longest of these bundles are 120 feet each, the others were made shorter, as being more convenient for the situation they would occupy in the line of suspension. From this arrangement it is evident, that each of the six main lines of suspension may be considered as one bundle, though consisting of many parts; they are made *fast at one extremity* to a plate of iron *firmly attached to the* stone gate before-mentioned, then to pass over the first ditch, across the stone support on the countergard, over the second ditch, over the second standard, and are finally made fast to iron bars, which, being attached to plates, are loaded with masses of stone and buried in the earth.

From the six principal lines other lines descend, consisting each of twelve wires only; these are made fast to the traverses, or pieces of wood which form the bases of the bridges. On these are mortised long pieces of carpentry, which are bolted together with them, and to which are fastened the railings of the bridges, and then other planks are fastened across these again, forming the path of the bridge.

The rapid and complete success of this undertaking, does great honour to M. Dufour. It was not quite finished at the time when M. Pictet wrote his account of it, but would be completed in a few days more. It had been planned and executed in the short space of six months. Its expense was previously estimated at 16,000 francs, and the cost amounted to within one or two hundred francs of that sum. This accuracy of estimation is not the least merit of M. Dufour, the engineer. The expectations with regard to the duration of the bridges are all in their favour; the iron is defended from rust by a thick coat of paint, which is to be renewed when required; the woodwork is of select materials, and not being any where in contact with the earth is not liable to rot.

Before constructing the large bridges, a model was made 38 feet long, and having only two suspending lines, each composed of 12 wires of 0.73 of an inch in diameter. The foot-way was constructed on 11 wooden traverses, which hung from the suspension lines, each by only four single wires, two at each end. This bridge was submitted to the roughest trials on the part of those persons who were curious to examine it, such as leaping, marching, &c. but without the least accident or failure.—*Bib. Univ.* xxiii. 305.

On a Phenomenon of Shadows.
BY M. MONGEZ.

WHEN the sun is free from clouds, the shadow of bodies is surrounded by a penumbra, very sensible, though much more obscure than the shadow; when two bodies, each producing a shadow, are

made to approach each other, at the moment preceding the contact, the shadows advance towards each other, and change their form at the point of contact; the shadow of a right line thus becomes a curve, and that of a globe like the summit of a paraboloid. M. Arago attributes the effect to the superposition of the penumbras accompanying the bodies; thus, if the intensity of the penumbras was only half that of the shadow, it would be doubled at the instant when the two were superposed, and thus produce an obscure part of equal depth with the shadow, which being added to it, would alter its form in that place.—*Bib. Univ.* xxiii. 323.

SUBSTITUTE FOR YEAST.

It frequently happens that patents are obtained for improvements in the Arts, which being neglected at the time, are afterwards discovered by other individuals, who lay claim to the invention, without knowing, or if they know, without acknowledging the merit of the original inventor. The following specification, taken from the Repertory of Arts, for September 1803, in which a process for making a substitute for yeast, is explained, though it never seems to have been put in practice till very lately, at least in this part of the country, is an example of the truth of this observation. The bakers in this city were much in want of a substitute for yeast, when some one more fortunate than the rest, discovered, or obtained a mode of making it, which was at first kept with great secrecy from those who were unacquainted with it; the utility of the process, however, could not long preserve it a secret, and it is now, we believe, universally known. This process is, we understand, from good authority, exactly, or very nearly the same, as that which was explained 21 years ago, in the following extract, which we now copy from the above-mentioned Journal for the benefit of the public.

Specification of the Patent granted to Peter Storck, *of John-Street, Tottenham Court Road, in the County of Middlesex, Baker; for a Substitute for Brewers' Yeast, which may be made and used in all Weathers, and in all Climates.*—Dated June 21, 1803.

To all to whom these presents shall come, &c.

To make the Fermentation.—Take six pounds of malt and three gallons of boiling water, mash them together, cover it close, let it stand three hours; then draw the liquor off, and put two pounds of brown moist sugar to each gallon of the liquor; stir it well about in the vessel until the sugar is dissolved; then put it in a small cask, only large enough to contain it; cover the bung-hole of the cask with brown paper only; let it be blood-warm; take care not to keep it in a cool place, lest you check the fermentation; let it stand four days; then prepare the same quantity of malt and boiling water in the same manner as last-mentioned, without sugar. Take the fermentation out of the vessel; mix it well together with the last-mentioned liquor, when blood-warm; let it stand forty-eight hours, when it will be fit for use. This fermentation, thus prepared, renders it unnecessary to make any new store whilst any of the same remains. To make twenty-six gallons (ale-house measure) of the substitute, allowing to each gallon two pounds of malt and one ounce of hops, and so in proportion for a less or greater quantity.

The Process.—Put twenty-six ounces of hops to twenty-six gallons of water; boil it for full two hours, so as to reduce the liquor to sixteen gallons. Then take the sixteen gallons of liquor so boiled, and mash it with the malt, when the liquor is one hundred and ninety degrees in warmth, or near boiling heat; let it stand two hours and a half, and then drain it off; put it in a clean vessel or cooler; take ten gallons of boiled water, of the same heat; mash it up with the before-mentioned malt; let it stand two hours and a half; then drain it off in another vessel or cooler. Take the first liquor, so prepared, when blood-warm, (or according to the state of the atmosphere at the time of making it,) and put to it four quarts of fermentation hereinbefore specified; mix it well; let it stand ten hours. Take the remaining ten gallons of the liquor, and put it with the said sixteen gallons of liquor, so prepared as hereinbefore is mentioned; let it stand six hours, and then it is fit for use, in the same manner, and for the like purposes, which brewers' yeast is made use of. A proportionable quantity of this substitute should be reserved as a store, for the purpose of fermenting other liquor, so as aforesaid prepared, to make more substitute for yeast. The advan-

tages attending this invention are, that the substitute for yeast will keep sweet and good longer than brewers' yeast, may be made and used in all weathers and climates, and is the means of making bread more white and lighter than brewers' yeast.

Directions how it is to be used.—Two gallons is sufficient for twelve bushels of bread, set quarter sponge, blood-warm; let it come to its full height, which it will do in four hours, or rather more; and keep it cooler than brewers' yeast throughout the whole process.

CONSTITUTION AND RULES AND REGULATIONS
OF THE
GLASGOW MECHANICS' INSTITUTION
FOR THE
PROMOTION OF THE ARTS & SCIENCES.

Opened, 5th Nov. 1823.—Rules passed, 19th and 25th Feb. 1824.—Incorporated, 22d March, 1824.

Original Committee of Management.

Mr. George Loudoun, President.
Mr. Hugh Barclay, Treasurer.
Mr. Alex. Marshall, Secretary.

David Wilson;	John Dykes;	William Reid;	John Wright;	John Sinclair;
Wm. Warren;	Wm. Murray;	Wm. Dobbie;	James Watson;	E. Wallace;
Francis Jenkins;	James Rankin;	W. Wither-spoon;	John Ross;	Arch. Smith;
John Liddell;	E. Dennistoun;		John Brown;	Wm. Harvey.

In the year 1800, Dr. George Birkbeck, while Professor of Natural Philosophy in Anderson's Institution, formed a Class for the gratuitous instruction of the Operatives of Glasgow, in Mechanical and Chemical Philosophy. The Class was continued by the successor of Dr. Birkbeck; and a Fee, in course of time, came to be paid by the Students. In the year 1823, the Members of this Class, in respect of various important reasons, ceased to be longer connected with Anderson's Institution, and formed for themselves the present Institution, on more independent and general principles, to be conducted under the following Rules and Regulations, which are declared to form its Constitution, and by which all its affairs shall be managed:—

I. *Name.*—This Institution shall be unalterably called, *The Glasgow Mechanics' Institution for the Promotion of the Arts and Sciences.*

II. *Property.*—The Property of this Institution shall consist in a Hall, Library-Rooms, Workshop, and other suitable apartments; with Books, Models, Apparatus, Natural Curiosities, and every other thing necessary for the furtherance of the objects of the Institution; and all which property is, and shall be, vested in the Committee of Management, named in manner herein after provided for, but always for the use and behoof of the Members of the Institution.

III. *Honorary Patron.*—The Members have already named Dr. George Birkbeck their Honorary Patron, and shall always have some distinguished Scientific individual as such, elected by the Members, who shall hold the office during the pleasure of the Members, but who shall have no control nor management in the affairs of the Institution.

IV. *Members.*—Every individual purchasing and holding a Ticket to the Lectures on Chemistry and Mechanics, shall be held a Member of this Institution, for the period of such Ticket, whether the same be a half or full course; and as such, he shall have liberty to attend the said Lectures, to receive Books from the Library, subject to its Regulations, and to have a voice in the affairs of the Institution. This last privilege, however, is for ever confined to the Members attending the Class of Chemistry and Mechanics, that Class being the first in the Institution, and mainly connected with its objects.

No individual who is chosen a Lecturer in this Institution, can be a Member of it, nor have any voice or vote in the general management of its affairs. But the Lecturers, nevertheless, shall have access to the Lectures of each other, and a preferable right to read in the Library, and visit the Museum, free of all charge.

Should any Lecturer wish to make any proposal, or give any notice to the Class, not connected with his Lecture, and interfering with the general management of the Committee, he shall previously give intimation of such proposal to the Committee, when they will lay it before the Class. Should the Committee object to such a proposal being submitted to the Class, the Lecturer is empowered himself to bring it before them, eight days after the time he first stated his wish to the Committee. When such proposal is made and explained, the Lecturer will immediately leave the Hall, when the Members will decide upon the proposal. Such proposal, it is understood, shall in no way interfere with any Article in this Constitution, which can only be affected in the manner pointed out by Article XX.

V. *Apprentices.*—For every hundred Students attending the Class of Chemistry and Mechanics, there shall be issued Five Free Tickets to such Apprentices, as shall be certified, to the satisfaction of the Committee, to be of good character, desirous of instruction, but unable to purchase Tickets for themselves. Such Apprentices shall have the liberty of attending the Lectures on Chemistry and Mechanics, and of receiving Books from the Library; but are not held to be Members of the Institution, nor to have any voice in its management.

VI. *Lectures on Chemistry and Mechanics.*—The principal course of Lectures shall be on Chemistry and Mechanics, and the election of this Lecturer is for ever vested in the body of the Members. The Fee payable for this course, and which entitles the Student to the rank of a Mem-

ber in this Institution, is, Ten Shillings for a full, or Five Shillings for a half course, or such sum which may in future be fixed on, as more suitable to the circumstances of the times, and value of the currency; the sum, however, being always such as to place instruction within reach of the operative Mechanic, that being the object of this Institution.

VII.—*Lectures on other Branches of Science.*—Such Lectures on other important and interesting Branches of Science, shall be delivered, as may be thought necessary by the Members of the Institution; but which Lectures shall in no way interfere with, or injure, the principal course on Chemistry and Mechanics; and the Students of such Classes, shall not, as such, be Members of the Institution. The Lecturers to the Classes shall, in the first place, be elected by the Class on Chemistry and Mechanics; but shall afterwards be re-elected or not, by the voice of their respective Classes. The Fees shall be fixed upon by the Committee, in conjunction with the respective Lecturers. The Committee shall have the same control and management over these Classes, as over the Class on Chemistry and Mechanics; and they shall be held as honorary Members of such Classes, without being obliged to purchase Tickets thereto.

All the Lecturers in the Institution, shall be annually elected to their respective offices.

VIII. *Library.*—The Library shall be formed of Books purchased with the Funds of the Institution, or gifted to it by individuals. So far as the Funds are applied, the Books shall be principally Scientific; but the Committee shall have power to purchase, in addition, such works on general Literature, as seem well calculated to convey useful knowledge and instruction. No work shall be purchased, or received in donation, which has an immoral or improper tendency. The internal management of the Library shall be regulated by separate Rules, already printed, and which shall always be prefixed to the Catalogue, but on which the Committee shall have power to make alterations, subject to the revision of the Members of the Institution.

IX. *Life Readers.*—An individual attending Five whole, or Ten half Courses, on the Lectures on Chemistry and Mechanics, on paying 2*s.* 6*d.* annually, shall have right to read in the Library, during his lifetime; but which right shall not be transferable.

X. *Discontinuance of the principal Course.*—Should the Lectures on Mechanics and Chemistry be at any time discontinued, the Members attending the last Course shall be entitled to the use of the Library for six months after the Course is finished; after which, the Library shall be open to the Mechanics of Glasgow in general, upon their finding security agreeably to the Rules of the Library, and paying, in advance, the sum of Six Shillings per annum, or One Shilling and Sixpence per quarter. The Committee of Management to be elected in the usual manner from among the Readers, who are, in this case, declared the Members of the Institution. When, however, the Lectures on Chemistry and Mechanics shall be resumed, the provision in this Article shall then cease, and the Library shall be again opened to the Members of the Class on Chemistry and Mechanics, in the manner already provided for.

XI. *General Committee.*—The Management of this Institution is hereby vested in a Committee of sixteen individuals, chosen in manner after provided for, by and from the Students of the Course on Chemistry and Mechanics; and the Committee, from their number, shall elect the Office-Bearers of the Institution.

XII. *Election of General Committee.*—Eight Members of Committee shall retire annually from the top of the list, who shall not be eligible to be re-elected for one year after so retiring.

On the last evening's Lecture on Chemistry and Mechanics, the President shall read the names of the eight Members retiring from Committee, and shall intimate that the nomination shall take place on the following Saturday. At this meeting, after the report for the last year has been read by the Secretary, and the conduct of the Lecturer considered, the Members shall proceed to put sixteen of their number in nomination, from which number eight shall be elected to fill the vacancies in the Committee. The nomination shall be conducted in the following manner:—One Member shall move, and another shall second the motion, that a certain Member of the Institution be put into the nomination; the Secretary shall take down the name and address of the mover and seconder, and of the individual suggested, and the President shall then put the question to the Members, whether the individual suggested shall be put in nomination or not; and, if a majority appear in favour of the motion, and after the individual has declared his willingness to act if elected, his name shall be taken down, and the President shall so proceed, until the list is complete, no Member being entitled to move or second more than once. The President shall then intimate, that on that night fortnight, the Election will proceed; and until which night the names and addresses of the individuals nominated, shall be hung up on the walls of the Library-Room. On that evening, there shall be given to each Member, at the door, on showing his Ticket, eight Tickets, marked with the Institution stamp. There shall be placed upon the table, sixteen boxes, each with the name of one of the individuals nominated, and these boxes shall be placed under the charge of the President and Secretary, but in view of the Members. The Members, on entering the Hall, shall pass in front of the table, and shall, in the face of the Class, put into the boxes of the eight individuals for whom he votes, one Ticket each, and shall not put more than one Ticket into each box. No Member shall be allowed to pass out of the Hall until the ballot is completed. At a quarter past the hour of meeting, the doors shall be closed, and the boxes opened in presence of the Members, their contents counted and checked, and the numbers taken down, by the Secretary; and the eight individuals having the highest number of votes, shall be held duly elected into the Committee.

XIII. *Vacancies in General Committee.*—In the event of the death or resignation of any Member of Committee, between the periods of Election, or of his absence for one month from the meetings of the Committee, he shall, after having received intimation, be held as having resigned; and, in all these cases, the general Committee have power to supply his place; but the Election must be made by the votes of two-thirds of the Committee present at a meeting specially called for the purpose, and the new Member shall take the place, in the list of Committee, of him whom he succeeded.

XIV. *Office-Bearers.*—The General Committee shall elect from themselves, a President, Vice-President, Treasurer, Superintendent, and Secretary; and shall farther sub-divide themselves into three Sub-Committees.

XV. *Committee of Finance.*—The Committee of Finance shall consist of the President, Treasurer, Secretary, and two Members. They shall collect the Fees arising from all the Lectures, and pay the Lecturers. They shall, in conjunction with the Superintendent, let the Hall, when it can be done without interfering with the business of the Institution; pay all the accounts, draw up all advertisements and notices to the Class, these being always first submitted to the General Committee; conduct all correspondence, and keep the minutes of the proceedings of the Institution. They shall docquet and authorise the payment of all accounts, and shall see that all Funds of the Institution exceeding Ten Pounds, be lodged in a responsible Bank, in the joint name of the President, Treasurer, and Secretary. The Treasurer's accounts shall be examined and docqueted every Three Months, by a Sub-Committee of three, named from the General Committee, but who shall not be Members of the Committee of Fi-

nance. These accounts so docqueted, shall be laid before the first General Meeting in May; and on that evening, a Committee of five, from the Class, shall be named, to examine the accounts and vouchers, and who shall report to the second General Meeting.

XVI.—*Library Committee.*—The Library Committee shall consist of the Vice-President and five Members, who shall have the management of the Library, and of the purchase of Books, voted in by the General Committee, docqueting the relative accounts; and they shall have power to call all the Members of Committee, in rotation, to assist in the giving out and receiving in of the Books.

XVII. *Apparatus Committee.*—The Apparatus Committee shall consist of the Superintendent and five Members, who shall have the charge of the Hall, Museum, and all the Apartments, Apparatus, Models, &c. of the Institution—shall superintend the making, or repair, of all Models, Apparatus, &c. and shall docquet the relative accounts.

XVIII. *Meetings of General Committee.*—The General Committee shall meet on the first Monday of each month, nine being a quorum. The President has power to call any extraordinary Meeting of Committee, and shall be bound to do so on the requisition of any five Members of Committee; and on his refusal, they may, themselves, call such Meeting.

XIX. *General Meetings of the Institution.*—There shall be two General Meetings of the Members annually—one on the first Saturday after the close of the Lectures on Chemistry and Mechanics, at which the Report of the Committee, for the previous year, shall be read, the nomination of the Candidates to serve in the Committee made, and the sense of the Members taken on the ability and conduct of the Lecturer on Chemistry and Mechanics, who shall be re-elected or removed by the majority of the Members;—the second General Meeting shall be on Saturday, fourteen days thereafter, on which evening the Election shall take place, and any other general business transacted. The Committee shall have power to call any Extraordinary Meeting of the Members, and shall be bound to do so, on requisition by fifty Members of the Institution, and who, on their failure, may do so themselves. Such Extraordinary Meetings must be intimated to the Members on the evenings of two successive Lectures, and by intimation, on the walls of the Library-Room; or, should the course not be current, by intimation on the Library-Room, and by advertisement in two of the most extensively read Glasgow Newspapers.

When any subject of minor importance, however, is laid before the Committee, by any Member of the Class during the course of Lectures, and the Committee refuse or delay to give redress, they shall be bound to lay the same before the Class, on a requisition subscribed by twenty Members; intimation being given on the previous Lecture night, that such subject is to be introduced.

XX. *Alteration of these Rules.*—It is expressly declared, that no alteration of, or addition to, these Rules shall take place, unless the same be sanctioned by the votes of two-thirds of the Members present at a Meeting convened for the special purpose, either by the Committee themselves, or on requisition by fifty Members, as before provided for, by Article XIX., and after intimation therein directed, and a copy of the proposed alteration, or addition, has been hung up in the Library-Room for four weeks previous to the Meeting. The General Committee shall have power, however, to make any by-laws for the better regulation of the Library and Class, which may not infringe on the present constitution, but which may be complained of to the Members of the Institution by any twenty Members, as provided for by Article XIX.

List of Patents, continued from our last.

To Robert Lloyd, of the Strand, in the County of Middlesex, Hatter; and James Rowbotham, of Great Surry-Street, Blackfriars-Road, in the County of Surry, Hat-Manufacturer, for their having invented and brought to perfection, a hat upon a new construction, which will be of great public utility.—19th Feb. Six months.

To Henry Adcock, of Summer-Hill-Terrace, in the Parish of Birmingham and County of Warwick, Gilt Toy Manufacturer, for his invention of an improvement in making Waistbands, or Umbilical, Ventrical, *Lumbar*, and Spinal Bandages, or supporters to be attached to Coats, Waistcoats, Breeches, Pantaloons, and Trousers, to be either permanently fixed, or occasionally attached and supplied.—19th Feb. Six months.

To William Church, of Birmingham, in the County of Warwick, Esq. for his invention of certain improvements in machinery for Printing.—19th Feb. Six months.

(To be Continued.)

NOTICES TO CORRESPONDENTS.

We thank U. S. C. for his observations, but they must be deferred till we again treat of the subject.—D. A. N.'s queries are of no importance; let him, or *them* solve those that are already proposed.—J. M., Coldstream, would oblige us by sending a working model of his machine, for which we shall pay him a handsome remuneration, if found to answer; in the meantime, we delay the insertion of his communication.—J. P.'s other communication must be deferred.—W. W. Duntocher, must be more explicit in his communication; his address will also be required.—J. W., Laurieston, under consideration.—W. S. will be inserted in our next; we shall be obliged by a continuance of his communications.—W.'s remarks on our observations and those of λ., may be just, but they are not very clear.

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J. CURLL, PRINTER.

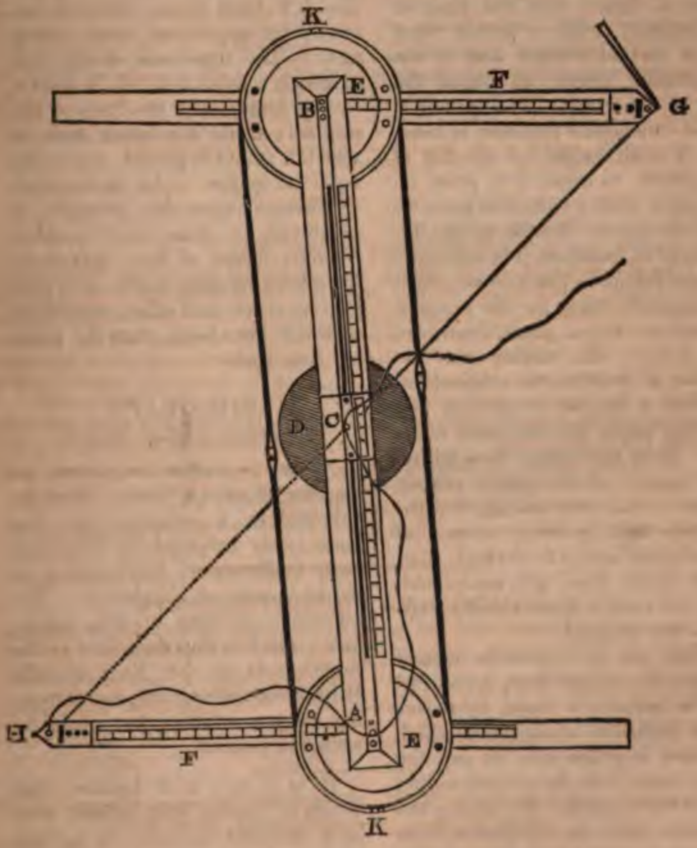
THE GLASGOW
MECHANICS' MAGAZINE.

" He who, through Nature's various walk, surveys
The good and fair her faultless line pourtrays;
Whose mind, profaned by no unhallowed guest,
Culls from the crowd the purest and the best;
May range, at will, bright Fancy's golden clime,
Or, musing, mount where Science sits sublime,
Or wake the spirit of departed Time."

Rogers.

No. XVI. *Saturday*, 17*th April*, 1824. Price 3*d*.

EIDOGRAPH OR NEW PANTOGRAPH, INVENTED BY PROFESSOR WALLACE.



ON COPYING INSTRUMENTS.

The most common instrument for copying drawings, is the Pantograph. By means of this instrument, the copy of a drawing may be made of the same, of a greater, or of a less size than the original. The Pantograph consists of four moveable bars, or rulers, commonly made of wood, fixed together by four pivots, and forming a parallelogram, having two of its adjacent sides prolonged, to admit of its being enlarged or diminished. At the extremity of one of the prolonged rulers, is placed a point, which is drawn over the lines of the original, while a pencil, fixed at the end of another arm of the instrument, traces on paper the lines of the copy. The pencil is placed in a hollow cylinder, or tube, with a small weight on the top of the pencil, to cause it to press on the paper with a sufficient force to draw the lines. Simple as this instrument is, however, it is not found so convenient in practice as might be expected; and, for the purpose of copying maps, plans, drawings, &c., artists still employ the old method of dividing the original design into a number of squares, and the copy-paper into the same number. They then draw lines within each square of the copy, exactly similar to the lines contained within each corresponding square of the original, and it is obvious, that, when these lines are completed, they will form a figure exactly similar to that original.

When the drawing to be copied consists of straight lines, a reduced copy is accurately made, by means of an isosceles triangle, in which the base, is to the side, as any line of the copy, is to the corresponding line of the original. By setting off, therefore, with the compasses, from the vertex of the triangle, any line in the original drawing, upon the sides of the triangle, the base which completes that triangle is the length of the corresponding line to be laid down on the copy. The same operation may be performed, without a triangle, by means of the sector.

If the copy of a drawing is to be made of the same size as the original, engravers commonly trace the copy on oiled or transparent paper, laid over the original.

A very simple Pantograph is frequently used, consisting of a rod placed vertically, and made to turn round a fixed point, situated between its upper and lower extremity. The upper end of the rod, in which a point is fixed, is drawn, by the hand, over the lines of the original; while the lower end, in which a pencil is placed, traces the copy on paper. An instrument, constructed upon this principle, is employed to draw small profiles. Various forms of this instrument have been recently made, with projecting arms, and other apparatus, to which have been given the name of *Apographs*.

EIDOGRAPH

Invented by Professor Wallace.

A very ingenious instrument for copying drawings, either upon an enlarged or a reduced scale, has been lately invented by Mr. Wallace, Professor of Mathematics in the University of Edinburgh. The following account of this instrument, which is thus described in the Supplement to the Encyclopædia Brittanica, will not only be interesting to our readers, but useful to artists in general.

It is a fact well known, that artists of various descriptions, who have frequent occasion to imitate original designs, have long felt the

want of a convenient mathematical instrument, by which a copy may be made with neatness and expedition, that shall have any given proportion to the original. The Pantograph is the only instrument that has been hitherto employed; but, although correct and plausible in theory, in practice it is found to be so very imperfect, that the artist hardly ever thinks of making use of it.

A consideration of the essential service that would be rendered to the graphic art, by a copying instrument, which should be at once simple in its theory and easy in its application, induced Mr. Wallace to turn his attention to the subject; and, in the summer of 1821, he produced the model of a copying instrument, which he has denominated an Eidograph.* The instrument, and its application to the copying of a great variety of subjects, has been shown to engineers, engravers, and other competent judges in London and in Edinburgh, and their opinion of its utility has been such as to leave no doubt of its completely fulfilling the views of the inventor.

The Eidograph is represented by the figure in the first page of this Number, and the following is the description of it.

The beam, A B, which is made of mahogany, slides backward and forward in a socket, C; the socket turns on a vertical axis, supported by the fulcrum, D, which stands on a table. There is a slit in the beam, through which the axis of the socket passes, so that, when the beam slides in the socket, a portion of it passes on each side of the axis. There are two equal wheels, E E, below the beam, which turn on axes that pass through pipes fixed at A B, near its extremities; and a steel chain passes over the wheels as a band, by which a motion of rotation may be communicated from the one to the other. There are two arms, F F, which slide in sockets along the lower face of the wheels, just under their centres: at the extremity, G, of one arm, there is a metal tracer, with a handle attached to it, by which its point may be carried over the lines in any design; and at H, the extremity of the other arm, there is a black-lead pencil fixed in a metal tube, which is ground to fit so exactly into a pipe, as just to slide up or down. In using the instrument, the pencil, in its tube, is raised by a thread which passes over a pulley, and it descends again by a weight with which it is loaded.

From the perfect equality of the wheels, it is easy to see, that, if the arms attached to them be placed parallel in any one position, they will retain their parallelism, although one of the wheels, and consequently both, be turned on their centres. Supposing, now, that B C and A C, the parts into which the axis is divided at the centre, have any proportion whatever to each other, if the distances of the tracing point, G, and pencil point, H, from the centres of their wheels, have the very same proportion, then it follows, from the elements of geometry, that the tracing point G, the centre C, and the pencil point H, will be in a straight line; and further, that C G and C H, the distance of these points from the centre, will have to each other the constant proportion of C B to C A, or of E G to A H. Such being the geometrical property of the Eidograph, if any subject to be copied, be fixed to the table on which the instrument stands, and the tracing point be carried over every line of the de-

* Form-copier.

sign, the pencil point will trace a copy in all respects similar to the original. To facilitate the adjustment of the instrument, so that the copy may have any given ratio to the original, there are scales of equal parts on the beam and the two arms: By these and verniers, both halves of the beam, and equal lengths on the arms, are each divided into 1000 equal parts, and at certain intervals corresponding numbers are marked on them. By means of the scales, when any ratio is assigned, the adjustment is made without the least difficulty.

To avoid any derangement by the chain slipping on the wheels, there are clamps at K and K, which hold it fast to the wheels at points where it never quits them. They are slackened when the instrument is adjusted.

The inventor has committed its construction to Mr. R. B. Bate, philosophical instrument-maker, Poultry, London, from whom it may be obtained.

CURIOUS QUESTIONS.

SHARE OF EXPENSE.

A Correspondent proposes the following question for solution. In re-building one of the tenements that were lately taken down at the Cross, a serious dispute has arisen among three proprietors about their just proportion of expense for the erection of a common stair-case. The state of affairs is this: A, possesses the first story, and of course requires only one stair; B, possesses the second, and requires another stair, with the use of A's; C, possesses the three upper stories, and therefore requires three additional stairs, with the use both of A's and B's; as, however, his uppermost stair, which leads to the garrets, is shorter than the rest, it has been agreed upon to reckon it only half a stair. The whole expense amounts to £200, which is to be paid upon the principle of general repairs. C, is willing to pay 5-9ths of the whole, and thinks it is exactly his share; he therefore demands 2-9ths of the expense from each of the other proprietors. This they resist, upon the following grounds: says A to them, I have no right to pay for your stairs, but only for my own, which, being the first, is necessarily used by you, while I never make use of yours; 2-9ths of the whole is therefore too much for my share, and you must both pay me a just remuneration for the use of my stair. Says B to C, what A says is very true; I have no claim upon him, but he has one upon me for the use of his stair; I have, however, also as much a claim upon you, for the use of mine, as he has for the use of his, and so I wont pay my 2-9ths of the expense till I see that it is my just share. Says C to them, you are both in the wrong, and will never convince me that my division is not correct; so pay me your 2-9ths a-piece, and let us have no more words about it. Messrs. A and B, not pleased at this summary mode of procedure, have refused to settle C's claims, and wish to know what is their just share, before paying it; pray, Mr. Editor, can you, or any of your Correspondents, help them out of their difficulty?

POINT OF MEETING.

Three men travel in a circle of ten miles in circumference, in the following manner: One man travels one mile the first hour, two miles the second hour, three miles the third hour, &c.; another man travels one mile the first hour, four

miles the second hour, nine miles the third hour, &c.; and the third man travels one mile the first hour, eight miles the second hour, twenty-seven miles the third hour, &c.; required the point, of time and space, where they will all meet?

B.

ON THE BAROMETER AND ITS USE.

The principle of the construction of the barometer is founded upon an experiment of Evangelista Torricelli, an eminent Italian Professor of mathematics, at Florence, who was born in the year 1608, and who died in 1647. This distinguished individual, having been employed by Galileo, another philosopher of eminence who flourished at that period, to investigate the cause why water did not ascend in pumps more than 33 feet above the spring or source, discovered, by repeated experiments, that this was occasioned by the pressure of the air, and that a column of water of about 33 feet in height is equal in weight to a column of air of the same base, reaching to the top of the atmosphere. Torricelli thence concluded, that if a column of water, 33 feet high, was a counterpoise to a column of the whole height of the atmosphere, then a column of mercury, of about two feet and an half in height, would also be a counterpoise to it, quicksilver being about fourteen times heavier than water. This being the case, he thought that a column of mercury, of about the 14th part of the height, would be equal in weight to a column of water, of 33 feet, and of course, would bear the same proportion to the weight of the atmosphere. This conclusion was soon proved to be just, for, having filled a glass tube with quicksilver, he inverted it, and placed it into a bason filled with the same substance, and had the satisfaction to perceive, that the mercury instantly descended till its height was about two feet and a half above the surface of that in the bason, as he had anticipated. This beautiful experiment has been denominated, from the name of the discoverer, the *Torricellian Experiment*, and it is upon this principle that the barometer is constructed.

Ingenious artists have, at different times, constructed barometers of various forms, many of them justly admired for their mechanism. The only one, however, to which I shall at present direct the attention of your readers, is that which is the most common, not only because it is the most simple, but the most accurate and useful, as from its construction it occasions little or no resistance to the free motion of the mercury in the tube.

This kind of barometer consists first of a glass tube, of about three feet long, hermetically sealed a one end, and open at the other. The diameter of the bore should not be less than two-tenths of an inch, nor, for common purposes, need it be more than four-tenths. In tubes of a very small bore, the glass sensibly attracts the mercury, so as to prevent its free motion, and in such cases, no alteration in the weight of the air can be seen, till it be so great as to overcome the force of the attraction of the tube. From this, it is obvious, that the wider the bore is, the more accurate will the instrument be, and the more easily will it be effected by the changes that take place in the atmosphere.

The next requisite, in this kind of barometer, is a small wooden

cup or bason, the circular area of which is generally thirty or forty times greater than that of the tube. A tube, with a bore of two-tenths of an inch wide, should have a cup of an inch and a quarter in diameter; for if it be too small, the mercury will rise and fall in the bason as well as in the tube, which would destroy the accuracy of the instrument. Sometimes the tube is bent at the lower end, and, instead of a wooden cup, a large hollow ball of glass is attached to it, so constructed as to allow free access to the external air to operate on the mercury which it contains, and which, as in the former case, must be connected with that in the tube. Sometimes a bag is used for holding the mercury, instead of the cup or ball; and in barometers constructed in this manner, the air is excluded from the mercury, the pressure being on the outer surface of the bag. Barometers constructed in this way are more convenient for carrying from one place to another, as by means of a screw generally fixed at the bottom of the frame of such instruments, the mercury can be forced up to the top of the tube, so as to prevent its weight from doing any injury to the glass or bag when it is carried in the hand. Accordingly, barometers used for measuring heights, are generally constructed in this way.

The third requisite to be noticed in this instrument, is a frame of wood, generally of mahogany, more or less ornamented, according to the taste of the maker. To the upper part of the frame is fixed a scale, commonly of brass, and plated with silver. The lower end of this scale is placed at the height of 28 inches above the surface of the mercury in the cup or bag, and is marked 28. This scale is three *inches long*, and is marked at the *top with the number* 31. Each *inch is divided into ten* equal parts. On the scale are also inscribed, at the proper places, words expressive of that kind of weather which generally happens at certain heights of the mercury. Opposite 31 inches are the words *very dry* for summer, and, if the scale be double, *very hard frost* for winter;—at 30½, *set fair* for summer, and *set frost* for winter;—at 30, *fair* on the one side, and *frost* on the other;—at 29½, *changeable*, serving both for summer and winter;—at 29, *rain* on the summer scale, and *snow* on the winter one;—at 28½, much rain and much snow respectively;—and at 28 inches, the word *stormy* is inscribed, serving for both sides.

In the barometers generally in use, however, the scale is only marked on one side for the summer, the other being divided for a thermometer which is, in most cases, attached to it. To this scale is also attached a moveable index called a *nonius*, or *vernier scale*, by means of which, the height of the mercury may be ascertained by inspection only, even to the hundredth part of an inch, every tenth part of an inch on the scale being divided into ten equal parts on the index. Such is a general description of this ingenious and useful instrument.

Should you deem this essay worthy of a place in your Magazine, I shall, in my next communication, consider its use as a weather-glass, or index, by which the state of the weather may be generally predicted; and on this branch of the subject, I will bring forward a number of rules (many of them the result of my own observations, and others extracted from books not generally to be met with) for judging of the weather, which cannot fail to be useful as well as amusing to such of your readers as may have this instrument in their possession, and may be inclined to make experiments with it.

W. S.

THE PRINCIPLES OF NATURAL, OR MECHANICAL PHILOSOPHY.

No. VII.

On the Equilibrium of a System.

ALL the bodies which nature presents to us, being composed of parts possessing sensible extension, we are unable, by immediate experiment, to verify the laws which have been discovered respecting any single material point insulated in space. It is, however, necessary to pass through this abstraction, before we can arrive at the more complex phenomena, presented by several points connected with one another by a mutual dependance, such as those of which bodies are in reality composed.

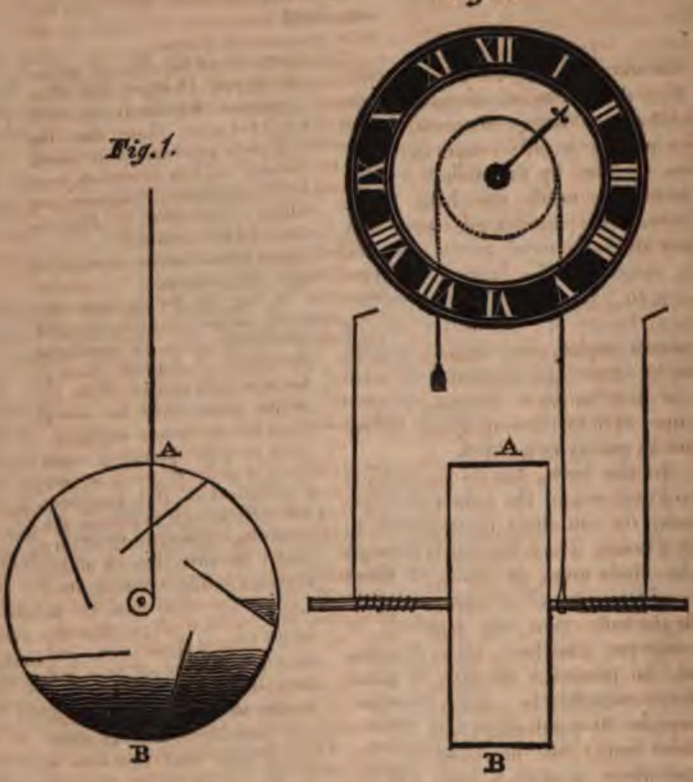
In this case, the forces applied to every one of the points of a system, do not limit their action to that point. They disperse it through the whole mass, in virtue of those conditions which render its parts dependent upon one another, in whatever positions they assume, and in whatever changes of place they experience. For example, suppose that the force acts upon a solid body; the mathematical characteristic of such a body will be, that all its parts are invariably connected with each other in such a manner as never to separate; and although, strictly speaking, there do not exist any natural bodies which possess this invariability in a degree entirely absolute, yet they can at least be considered as such, whilst their contexture resists the action of the forces to which they are submitted. But the rigidity which characterises such a system, will evidently require that its parts mutually transmit the impression of the forces which solicit some amongst them, since, whenever any single part is impelled in any direction, it drags all the other parts along with it in its motion. Again, suppose that the force acts upon a liquid body; then, the impenetrability of the different parts which touch each other, is the only condition which impedes their motions, and which regulates the share of the applied forces to every point of the whole mass.

In general, all the imaginable conditions of connection between the parts of a material system, are always reduced to this, that some of its points will be compelled to remain on given surfaces or lines, or they will depend on one another in their motions, so that one cannot change its position in one direction, without causing one or more of the rest to experience a corresponding change in its position. All this can be artificially imitated, if we consider the system as composed of material points at first insulated and free; and then, in the second place, connected with one another by cords more or less extensible and flexible, agreeably to the nature of the motions which they undergo. Thus, the connection which renders them dependent, is always reduced to the pressures or tractions exerted by those cords; thus, also, the motion or the equilibrium of every point of the system will be determined as exactly as if it were free, but solicited by the united action of all the forces; and the general condition of the equilibrium, or motion of the whole system, will consist in this, that all the individual conditions can be fulfilled at the same time without interfering with each other.

(*To be Continued.*)

CLEPSYDRA, OR WATER-CLOCK.

Fig. 2. *Fig. 1.*



MR. EDITOR,—I have seen the above clock, among the Philosophical Apparatus, in the Marischal College, Aberdeen. I have seen it no where else; and although I believe it is no new thing, perhaps it may be new to many of your readers; and if you think so, you are welcome, Sir, to insert it in your Magazine.

Fig. 1. is a section, and fig. 2. a front view of a water-clock, which, when fitted up with a transparent dial-plate, and a small lamp placed behind it, makes a very cheap and *quiet* time-piece for a sick chamber. A B, is a vessel of tin-plate, in the form of a grindstone, about five inches diameter and two deep, made water tight, and soldered upon a small, straight, round, steel axle. The interior, or inside of the vessel, is divided into five apartments, as shown in the section; these apartments are all open towards the centre; and each of the five plates forming the said apartments, is perforated with a small hole, near the place where it joins the circumference. Through these holes a quantity of distilled water finds its way, slowly, from one

ment to another, successively, ng as the threads by which the l is suspended allows it to de- l. The exact distance through h the centre of the axle descends 2 hours, being found by trial, ircumference of the pulley fixed e pivot of the index, is made l to the said distance; of course, ndex will move once round in ours. To wind up the piece, is ly to turn round the vessel the se way, until the index goes 12 s backwards.

AN OBSERVER.

leston, 15th Jan. 1824.

he above instrument, though simple, has one objection, ely, that it requires frequent ling up. Whether it might not constructed as to make it go longer time, by increasing the tity of water and the size of cylinder, or diminishing the ll hole through which the water les, we leave some of our in- ous Correspondents to deter- e. In the mean time, we shall lude our remarks by a short ory of the invention of clep- æ, or water-clocks, in general; respect to the particular form he above apparatus, however, have no where seen a descrip- of one exactly the same, though principle on which it is con- cted is used in most instruments he same kind.

itruvius, the Roman architect and anist, ascribes the invention of the r-clock to Ctesibus of Alexandria, flourished in the reign of Ptolemy rgetes, about 245 years before the istian æra. The same author says machine was first introduced at Rome . Cornelius Scipio Nasica, U. C. 594, 57 before the Christian æra. There ars reason to believe, it was *first* in- uced at Rome into courts of justice Greece, as it had been originally in ece used for this purpose; the Ro- orators being guided in the time they occupied the court, by this instrument, as we may learn from this expression of Cicero, "*Latrare ad clepsydram.*"

Cicero also informs us, that it was first introduced into courts of justice in the third consulate of Pompey.

Thus, by this road we discover the inventions of Egypt, Chaldea, and other oriental countries, constantly travelled to Rome and the west. Long since the respective periods previously mentioned, has the honour of this invention been claimed by Burgundians, Bolognese, and other Italians; sometimes by Frenchmen, but chiefly by Germans.

Their claim for invention seems to be questionable in numerous instances, whatever it may be for *improvement*; they certainly cannot, consistently with the rule previously given, be considered as the *first inventors*; although there is nothing to be alleged against these respective people being the *discoverers* of designs which had a previous existence.

With equal or much propriety might the Arabians, in point of time, be considered as inventors of this machine; and they are well known to possess the least claim to original invention of any people. They, however, have a merit, notwithstanding; but it is of a negative species, for those arts and sciences, which, by chance, were saved from the destruction of their bigoted ignorance, and which, when the fortune of war had thrown into their hands those pure designs of intellectual Greece, mere accident had wrested from their zealous fury. These they transmitted to a more ingenious people as pure as they received them; but upon precisely as good grounds as the before-named Europeans claimed this *original invention*, might the Arabians have assumed that honour. For we read that Haroun al Raschid, caliph at Bagdad, then the chief seat of Saracen empire, sent, as a present to Charlemagne, a clock of curious workmanship, which was put in motion by a *clepsydra*; which instrument is said, by Dr. Adams, "To have been used by the ancients to measure time, by water running out of a vessel."

It consists of a cylinder divided into several small cells, and suspended by a thread fixed to its axis in a frame, on which the hour distances, found by trial, are marked out: as the water flows from one cell into another, it changes very slowly the centre of gravity of the cylinder, and puts it in motion.

The form of this instrument is thus described by Professor Beckmann:—"The most common kinds of these water-clocks, all, however, correspond in this, that the water issued drop by drop through a hole of the vessel, and fell into another, in which a light body that floated, marked the height of the water as it rose, and by these means the time that had elapsed."

The most improved form the same instrument hath acquired, is thus described by the same author, from one in his own possession.

"Among the newest improvements to this machine may be reckoned an alarum, which consists of a bell and small wheels, like those of a clock that strikes the hours, screwed to the top of the frame in which the cylinder is suspended. The axis of the cylinder, at the hour when one is desirous of being wakened, pushes down a small crank, which, by letting fall a weight, puts the alarum in motion. A dial-plate with a handle is also placed, sometimes, over the frame."

Father Kircher, describes several kinds of water-clocks in his *Ars umbræ et lucis*, first published in 1643. In respect to the invention of clepsydræ, we should think the original inventor took his first idea from the use of an instrument, common in Egypt, which that people called a Canob, or Nilometer, being a large stone vessel of the shape of a sarcophagus, into which water was daily poured, by proper officers, during the increase of the Nile, to show the people whether they had a prospect of plenty, or were to expect a scarcity in the ensuing year. As the fall of the water, after it had risen to a due height, was of equal importance to them; so the water was suffered to run out proportionably to its decrease in the river, being ascertained by just and equal marks they generally well understood.—*History of Inventions and Discoveries.*

ON WINDOWS.

Mr. Editor,—In your Magazine, No. XIII., I observe a plan and description of an Improved Window, by a Mr. Johnston. It is surely praise-worthy to invent or improve any thing that may preserve the lives of our fellow-creatures, when they are in danger, but I am afraid that his plan will not add much to the comfort of the inhabitants, or to the utility and durability of the windows.

My first objection is, that "by adding sliding frames of wood to the sashes," day-light will be greatly diminished in the inside, and the windows will have both a gloomy and clumsy appearance. My next is, that it will hardly be possible to keep the windows water-tight, owing to the *shifting piece* on the sill. There is also by far too much rigging about this plan of windows for servants to attend to, as it is well-known that even fastenings of the most simple kind are frequently put wrong owing to their inattention.

If the windows at present in use are properly *double hung*, they can be turned outside in, with more facility than those on Mr. Johnston's plan; especially if they be so constructed that the ropes by which they are hung, are made fast on a line with the cross astragal, or bar, forming, as it were, an axis on the centre of the sash; so that, by removing the batten and parting rods, the sash can very easily be turned outside in. They could also be greatly improved, and more easily turned, by putting three brass-headed thumb-screws in the bught of each batten rod, fixed into nuts sunk flush into the breast, or inside facing, so as to allow them to be removed without injuring the paint, &c. The ropes might also be fixed, with copper hooks and eyes, into the grooves made in the sashes for receiving them.

these, and a few additional ɡ repairs, were made on the ɑon windows, the most ignor-indow-cleaner might be taught rn the sashes in three minutes; ieve, indeed, that such people are commonly idle, and dis-st, owe 9-10ths of their work ɑaginary danger of their own ion, and there is little doubt hey would all be against any ɔvements on windows, be-servants could clean them easily, and to better purpose. e is, really, no more danger ding their business, than that ich plumbers, slaters, wrights, run a risque every day; but generally proceed more me-cally to work.

ith regard to altering all the windows in town, to suit Mr. J.'s plan, I will not say it is impossible, but I think it will be highly improper; because, to reduce the style, would ruin the tenon, rebates, &c., and cause the sash eventually to fall asunder. As, however, we have a number of able architects, and intelligent tradesmen, in Glasgow, some of whom, perhaps, may be induced to give you their opinion, and enter the lists with Mr. Johnston, who has come forward so manfully and thrown the gauntlet, I refrain from troubling you with any more of my comments, but remain,

Sir, your's, &c.

A JOURNEYMAN WRIGHT.

Glasgow, 6th April, 1824.

:VIEW OF 'CRITICAL RESEARCHES IN PHILOLOGY AND GEOGRAPHY,' pp. 202.—*James Brash & Co., Trongate, Glasgow.*

publication does honour to ity and University of Glasgow. Researches in Philology con-fearless exposure of the errors less a man than the celebrated ,ee, professor of Arabic in the ersity of Cambridge, in his n of Sir William Jones's Per-Grammar. Though we con-urselves unable to follow the r in all his inquiries, yet hav-read his strictures carefully gh, we are convinced, from we did understand, that the d Dr. has fairly laid himself to the just, though severe re-s of our author; and glad in-were we to find, that a fellow-ɪus of our own Alma Mater ble to enter the lists with such inguished personage, and to t himself in such a highly cre-e manner.

ough the first part of these rches does not fall in with the nature of our publication, we trust our readers will excuse us for thus calling the attention of the public to a work, which, while it reflects great honour on the author, shows that oriental literature is not confined to the precincts of the English universities, and that this city possesses one individual at least as worthy of an Oriental chair as any in the sister country.

The author's critical remarks on the labours of Dr. Lee are well summed up in the following expression, (to the justice of which, from the examples adduced, we have no hesitation in giving our assent), in which he says, "it is difficult to decide whether the Professor's knowledge of the Arabic or French language be the most defective." See p. 75 of the Researches, to which we refer our readers.

The work abounds throughout

with excellent remarks on general grammar, and particularly on the mode of studying it; circumstances which render it well worthy of the perusal of the student.

The second part of this work, which contains the Critical Researches in Geography, is more immediately adapted for review in our pages, and therefore we hasten to notice its contents. This part is written by a different author, no less known to us than the former, and we feel glad in assigning to his labours an equal meed of praise. Often have we travelled with him over those miniature representations of the various countries of the world, denominated maps; much have we learned, and much might we still learn from such profitable journeys in his company. It was therefore with no ordinary feelings that we perused our friend's critical labours, and observed that in his usual manner he had bent the whole force of his mind to the object of his researches. This object is "An Examination of the various Opinions that in modern times have been held respecting the Sources of the Ganges, and the Correctness of the Lamas' Map of Thibet."

These interesting and scarcely explored regions, containing the highest elevations on the surface of the globe, and, consequently, forming a source of wonder and delight to the traveller and admirer of the stupendous works of nature, cannot fail to interest the general reader; and on this account we consider no apology necessary for giving a few extracts from our author's performance, in which, for our part, we would put more confidence than in most geographical disquisitions that have fallen under our notice.

"The recent expedition of Captain Webb, to ascertain the sources of the Ganges, in 1808, completely verified the sagacious conjecture of the illustrious President of the Asiatic Society, and that of his brother the late Colonel Colebrooke. The Bhagirathi was traced so far as Batheri, situated in 30.49 N., and 45 geographical, or 52 British miles N. E. of Hurdwar in direct distance. In traversing this comparatively small space, not less than eighteen days were occupied. This arose from the very rugged nature of the country, inducing a continued succession of toilsome, laborious, and difficult marches over mountains, rising behind each other in constant succession, and from the very sinuous course of the stream. Between Nagal and Mugra, a distance of only 10 miles, they crossed, successively, three mountains of 2000, 1200, and 3297 feet above their respective vallies, in perpendicular height. From Batheri, a select party was dispatched, under the guidance of the Moonshee, or Persian interpreter, in order to accomplish what Webb found himself unable, at that time, to perform, as he had also the Alucknundra to explore to its source. This personage, accordingly, reached what he conceived to be the very source of the stream, in a very deep and large valley, covered with snow, about three miles beyond Gangoutri. This latter part of the journey occupied seven days, the direct distance being 40 British miles. By this survey, Gangoutri was placed in 31.4 N. L. and 78.59 E. L. and 100 miles S. E. of its position in Rennel's map. The Alucknundra (Alacananda) was, also, traced to the source of the Vishnu Ganga, its northern branch seven miles beyond Bhadrinath, in 30.48 N. L. and 79.38 E. L. 2.27 S. and 1.52 W. of its hitherto supposed source in the Mansaroar lake, as laid down in Rennel's map. This source, like that of the Bhagirathi, lay concealed under an immense bed of snow, which no traveller has ever surmounted, or can surmount, and 20 miles S. of the base of the central ridge of the great Himalaya. In a subsequent journey across the central range itself, performed by Messrs. Moorcroft and Hearsay, in 1812, the Dauli, or S. E. branch of the Alucknundra, which, from its superior volume of water, and greater length of course, must be regarded as the main branch of the Ganges, was traced upwards to within 12 miles of its source, at the immediate base of the great central ridge in 31.4 N. L. and 79.45 E. L., the same latitude as Gangoutri, 46 miles E. of that

horizontal distance, and 155 of its supposed origin in the ar lake, as represented in Ren-. But, though all these ascer-cts fully proved its sources to be ie southern slope of Imaus, or a, and completely disproved the of the Lamas' map, which de-m from the Mapang lake, and aisse, or Kanteshan mountains, croft's map has confirmed their , in the following respects :— re are really two such lakes as tioned laid down in their map— ver actually flows through them to the W., and which actually indoostan—that these lakes are ith tolerable accuracy relative to r—that in respect both of lon-d latitude, they were placed far rrectly than in the maps of le, Tiefenthaler, Anquetil du Rennel, and Arrowsmith—and, at the other stream which they northern branch of the Ganges, rises to the N. of these lakes, N.W. of the stream which en-Mansaroar lake."—p. 112-114.

Webb, who has, since that assiduously and meritoriously d his geographical inquiries and labours, amidst the stupendous the Heemalleh, had an inter-h the chief of Takklacote, who him that the Mansaroar, or lake, had a western outlet, (fre-lry, however,) into the Rawan-Lanken, and that upwards of ams fall into it from the con-anges to the S. E. Such testi-this, the testimony of a native l resident governor, in its very decides the question. Next to spection and continued personal on, it is the strongest of all Mr. Webb is also of opinion, considerably more elevated than anhrad, and that a subterrane-ous communication must exist between them, as one periodical channel could not possibly carry off all the waters of the numerous streams mentioned above, which are successively poured into it from the surrounding mountains. Moorcroft was there in the beginning of August, when the sacred lake should have been at its highest flood, from the melting of the snows of the surrounding mountains. The highest flood-mark, however, which he could discover, was only 4 feet above its then existing level. This was, certainly, a strong presumptive proof of a subterraneous communication with the Rawanhrad, or otherwise the evaporation must have been prodigious, to have carried off such a redundancy of water from the melting of such bodies of accumulated snow. That the annual accumulation of snow during the winter season must be prodigious, may be safely inferred from the vast elevation of the lake and the mountains in its immediate vicinity. If the bed of the Setledge, nearest the Nitee Pass, be 14,924 feet of elevation, by Mr. Webb's measurements, the Mansaroar cannot well be less than 16,000 feet above the level of the sea. This dividing isthmus of land, connecting the Caillas and the Heemalleh, and sending off the waters in this part of Asia to various points of the compass, is perhaps the most elevated in the world, and cannot well be estimated at lower than 18,000 feet, whatever more; and the mountains themselves, thus connected, must be at least 26,000 feet in height. Thus the veracity, and, consequently, the authority of the Lamas' map, has been strengthened by Moorcroft's visit to the very spot, and Webb's inquiries in its immediate vicinity."—p. 120, 121.

We shall give another curious extract, from these interesting Researches, in our next Number.

VARIOUS COMMUNICATIONS.

REPLY TO G. M.

EDITOR,—As a native I cannot ng interested in any project that ts object the embellishment of d City of the Empire,—and it no ordinary feelings of pleasure oked upon a design in one of the mbers of your Magazine, for a building as the commencement of the New Street to run from the Cross in a straight line, towards, and forming a junction with Monteith Row. My admiration of that design was not founded upon the magnificence of its appearance merely. I was convinced of its utility—not only in point of remuneration from

alphabet, there seemed nothing more to discover and expand his genius. He applied himself to study, and he arrived at the knowledge of the most sublime geometry and analysis; without a master, without a conductor, without any other guide than pure genius.

"At eighteen years of age, he had made these considerable advances, without being known, and without knowing himself the prodigious extent of his acquisitions. The Duke of Argyle, who joined to his military talents a general knowledge of every science that adorns the mind of a man of his rank, walking one day in his garden, saw, lying on the grass, a Latin copy of Sir Isaac Newton's celebrated Principia. He called his servant, and desired him to take it and carry it back to his library. Our young gardener told him that the book belonged to him. 'To you!' replied the Duke, 'Do you understand geometry, Latin, Newton?' 'I know a little of them,' replied the young man, with an air of simplicity, arising from a profound ignorance of his own knowledge and talents. The duke was surprised, and having a taste for the sciences, he entered into conversation with the young mathematician; he asked him several questions, and was astonished at the force, the accuracy, and the candour of his answers. 'But how,' said the duke, 'came you by the knowledge of all these things?' Stone replied, 'a servant taught me to read ten years since; does any one need to know any thing more than the twenty-four letters, in order to learn every thing else that one wishes?' The duke's curiosity was redoubled; he sat down upon a bench, and requested a detail of his proceedings on becoming so learned. 'I first learned to read,' said Stone; 'the masons were then at work upon your house; I went
near them one day, and saw th
tect use a rule and compasses,
he made calculations. I enqui
might be the meaning and use
things; and I was informed th
was a science called arithmetic
chased a book of arithmetic, and
ed it; I was told there was
science called geometry; I bo
books, and I learned geometr
reading, I found that there w
books of these sciences in La
bought a Dictionary, and I lea
tin; I understood, likewise, th
were good books of the same
French. I bought a Dictionar
learned French. And this, my
what I have done; it seems to
we may learn every thing when
the twenty-four letters of the
This account charmed the du
drew this wonderful genius ou
obscurity, and provided him wit
ployment which left him plent
to cultivate the sciences. He di
to him, also, the same genius fo
for painting, for architecture, an
sciences which depend on cal
and proportions."

What was the particular natu
employment which the duke c
on Stone, we are not informed
we may credit a writer in the
Review, (vol. ix.) it was far fr
ranting the description given
Ramsay. "His abilities," s
writer, who appears to have spok
personal knowledge of Stone, "
versally acknowledged, his re
unblemished, his services to th
uncontested, and yet he lives t
vanced age unrewarded, *except b
employment that reflects dishonou
donor."—Per. Anec.*

NOTICES TO CORRESPONDENTS.

We recognize in 'D. H., Rutherglen Bridge,' an old Correspondent, who has frequentl
different names and different hand-writings; we would willingly insert some of his comm
if he would leave off his troublesome "I would advise," and "I think," and "I hope,'
we *would advise* him, if he has any thing of importance to communicate, to abolish such
expressions from his vocabulary, and to give a simple and connected account of it, free of
step-and-jump style so prevalent in his writings, as well as those of some of our cotem
B. Z. will be attended to.—'A West Indian' will oblige us by sending his more important
cations *first.*—W. C., 'A Prentice,' D. B., J. C., D. L. M., and C., under consideration.—
'A Hamiltonian,' have been received.—We are in arrears with some of our Corresponden
hope to overtake their communications soon.

Published every Saturday, by W. R. M'PHUN, 155, Trongate, Glasgow,
Communications (post paid) must be addressed.

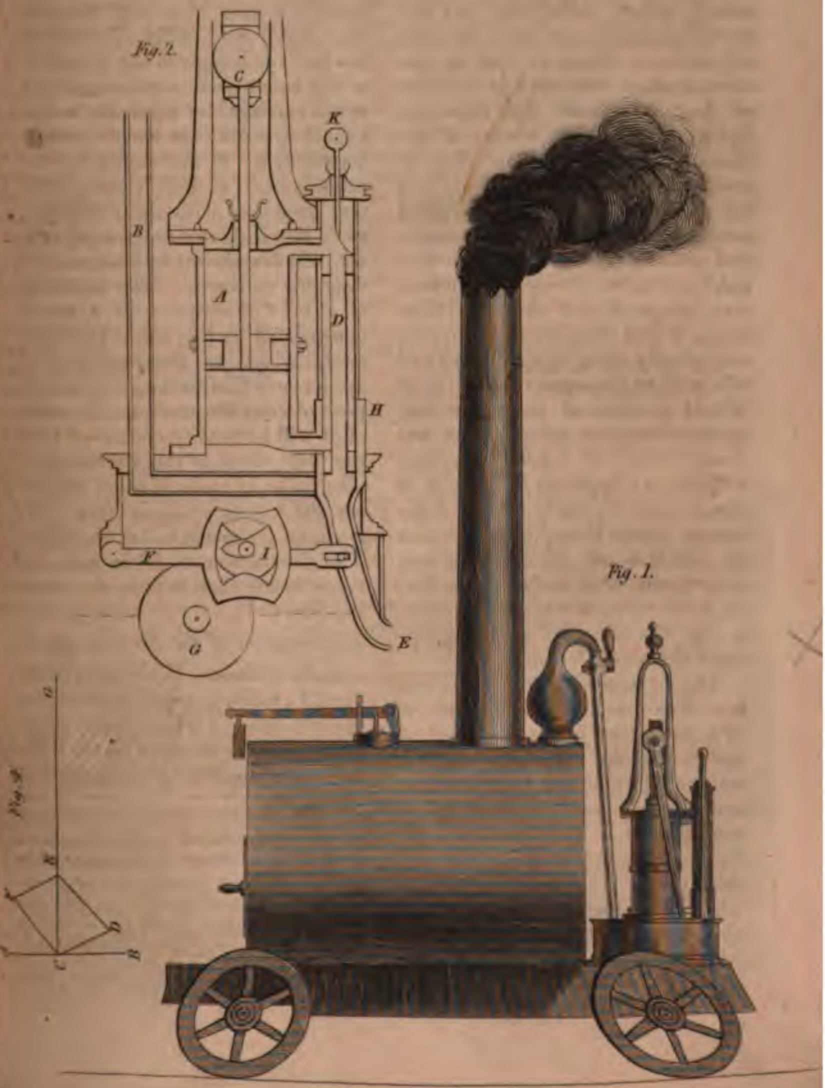
J. CURLL,

THE GLASGOW
MECHANICS' MAGAZINE.

" Come, bright Improvement! on the car of Time,
And rule the spacious world, from clime to clime;
Thy handmaid arts shall every wild explore,
Trace every wave, and culture every shore."—*Campbell.*

No. XVII. *Saturday, 24th April,* 1824. Price 3*d.*

LOCO-MOTIVE STEAM ENGINE.



LOCO-MOTIVE STEAM ENGINE.

MR. EDITOR—The steam engine is undoubtedly one of the greatest and noblest inventions which the genius of man has ever produced, and it may with justice be denominated one of the wonders of the world. It is not only the beautiful adaptation of one part of the machinery to another, and the regularity and equality of motion obtained, which we admire, but the useful purposes to which it is made subservient. Suppose that an ancient Roman, who lived in the time of Augustus Cæsar, that most enlightened era in the history of the Roman empire, was now alive to contemplate its powers, would not his mind be filled with the mingled sentiments of wonder, astonishment, and even fear, at beholding such a noble spectacle. To see ships, whose size, independent of other considerations, would astonish him, moving majestically along against wind and tide with an immense velocity, or to behold a piece of inanimate machinery dragging behind it an immense train of loaded waggons, without any apparent application of power, would utterly confound his senses. Great though this invention be, yet it is not the result of one experiment, or of one man's genius; no, like every other great invention, it was the effect of much experiment and much labour.

The expansive force of steam was first discovered by the Marquis of Worcester, and it was employed by Savery for the purpose of raising water by the alternate force of steam, and the vacuum produced by its condensation. The next step was Newcomen's invention of the moveable piston and working beam, whereby a reciprocal motion was obtained, which was employed to *raise water by* pumps, or was easily converted into a rotatory motion, which became a prime mover of machinery. But all these improvements were accompanied by many deficiences and imperfections, until Watt turned his penetrating genius to the subject. To him, we are indebted for the separate condenser* and double stroke, &c. which has made the steam engine so useful and gigantic a slave as it is at the present day. And lastly, Trevithick has had the honour of the invention of the loco-motive steam engine, or steam carriage, by which the use of animal strength is at length entirely superseded. In this engine he employs steam of high elastic force, and dispenses with the condenser, as it requires no condensation water, which makes it well adapted for dragging carriages. The following is a brief description of a model constructed on the above principle, lately added to the apparatus of Anderson's Institution, for the purpose of class illustration. The form of it will be readily conceived from the plan given in the engraving.—The boiler is made of sheet copper, and the engine, which is brass work, is placed at the one end of the boiler. The size of the model is only five times larger than it is in the drawing, fig. 1.

Explanation of the Section, fig. 2.

A, the cylinder; B, the main steam pipe; C, a friction wheel in the centre of the common T shaped beam, which makes the piston move parallel. To the ends of the beam are attached two

* The separate condenser was the result of an experiment made by Mr. Watt, upon a model of Professor Anderson's, while he was repairing it; and this grand experiment was performed in an old cellar (the door of which fronts the street,) in the first wide entry above the beef market, King-Street.

connecting rods, which work a double crank at the axis, I, where the motion is communicated by two teeth wheels to the axle, G, to which the propelling wheels are attached. F is a lever, by which the valves are wrought by the stud on the axis, I. The two connecting rods which are attached to the end of the lever, work the valve piston, K. D is the common tube slide valve, which is surrounded by steam, supplied from the main pipe, where it enters, concealed in a small pedestal at H. The under port-hole, represented open in the figure, allows the steam to enter under the piston, which is forced up by the steam; at the same time, the steam that was above the piston, escapes down through the tube D, and is at E discharged into the atmosphere. When the engine is to be set at work, the furnace is charged with ignited charcoal, which soon raises enough of steam† to make the carriage travel off with a number of loaded waggons behind it, round the lecturer's table, on a circular road, eight feet diameter.

I am, your's, &c.

J. C.

Anderson's Institution, April 21, 1824.

† The pressure here employed is 30 pounds to the square inch.

The above is a short description of the beautiful model of the locomotive steam engine, which performed its part so admirably at the lecture given by Dr. Ure for Mr. Cross's children. We are indebted to the maker of the model for this account of it; and it is no small merit indeed, that a mechanic should be able to give such an elegant drawing and description of his own machinery. We understand that he intends to construct an engine on the same plan, to be only 3 inches in length! This will be unquestionably one of the eighth wonders of the world.

Fig. 4 refers to Article 2d, p. 227, No. XV.

ON THE APPLICATION AND USE OF THE BAROMETER.

1st, On the use of the Barometer as a Weather-glass, or Index, by which the changes of the weather may be *generally* predicted:

I have already stated, that the motions of the mercury, up and down the tube, are occasioned by the variations which take place in the weight of the atmopshere. The weight of the air being ascertained to be different, at different times, even in the same place, by the variations of the mercurial column, it would not be long before it would be observed, that these variations were always succeeded by certain changes in the weather. Hence, this instrument soon came into use, as a means of foretelling the changes of the weather; from this application it received the name of the *Weather-glass*, and it was denominated the *Barometer*, from its measuring the weight or pressure of the air. In using the barometer as a weather-glass, the words *stormy*, *much rain*, *rain*, *changeable*, &c. usually engraven on the scale, though found very generally to agree with that kind of weather which they indicate, ought not to be regarded so much as the rising or falling of the mercury in the tube. If the mercury stand, for instance, at 28½ inches, or *much rain*, and rise to 29½, or *changeable*, this is a sure indication of fair weather, although it will not continue so long as if the mercury had risen to a greater height. On the other hand, if the

mercury stand at 30 inches, or *fair*, and fall to 29½, or *changeable*, this presages foul weather, though not so long a continuance of it, as if the mercury had sunk still lower in the scale. Even the actual height or depression of the mercury in the tube, ought not so much to be attended to by the observer, who would predict the weather accurately, as its movements up and down. For, to form a just estimate of the kind of weather that may be expected at any time, he ought first to ascertain *whether the mercury be rising or falling*. To discover this, the following directions will be found useful.

1st, If the surface of the mercury at the top of the column be convex, that is, if it be higher in the middle than at the sides, the mercury is rising.

2d, If the surface be concave, that is, if the mercury be hollow on the top, having the appearance of a small cup, then it is falling.

3d, If the surface of the mercury be level, or only a little raised in the middle, the mercury is stationary. Even when it is stationary, however, the mercury will naturally be a little convex, because the particles of that fluid attract one another more forcibly than they are attracted by the sides of the tube.

4th, If the tube be one of a very small bore, it will be necessary, for ascertaining the state of the mercury, to shake the instrument gently, and if the air has increased in weight since the last observation, the mercury will rise about the twentieth of an inch higher, but if the air be diminished in weight, the mercury, by the gentle shaking, will sink as much. The reason of this is, that in small tubes the attraction of the glass is so very considerable, as to prevent the free motion of the mercury, till it be disengaged by putting it in motion. When an observation is to be made with a barometer having such a small tube, this last direction ought always to be attended to, because the mercury will sometimes not vary of its own accord, till the weather, which it ought to have indicated, be actually present.

A great, if not the chief cause, of the rising and falling of the mercury, seems to be the variations of the wind in the temperate zones, and especially in insular countries, such as Great Britain. Another cause is the uncertain exhalation and precipitation of the vapours floating in the air, by which it becomes much more loaded at one period than another, and consequently it must vary in its weight at different times. This latter cause, however, is dependent in a great degree upon the former. On these principles, the celebrated Dr. Halley has endeavoured to explain the various phenomena of the barometer, and the following are some of the most important results of his observations.

"1st, In calm weather, when the air is inclined to rain, the mercury is commonly low." The reason of this is, that the air being then lighter than at other times, the vapours are no longer supported by it, and consequently they descend towards the earth, having become specifically heavier than the medium in which they previously floated, and in this descent meeting with similarly moist particles, they incorporate together, and at length fall to the ground in drops of rain. The same effect, however, may be produced by contrary winds, which, when they blow from the place where the barometer stands, may so diminish the pressure of the incumbent air, as to cause the mercury to sink in the tube when there is really no rain in the place of observation. When, however, there has been no storm of wind, then the

mercury's being low, always indicates rain or snow.

2d, "In serene, good, and settled weather, the mercury is generally high." This evidently requires no separate illustration, as it may be accounted for upon principles the reverse of the preceding.

3d, "Upon the occurrence of very great winds, though not accompanied with rain, the mercury sinks lowest of all." This is owing to the very rapid motion of the air in high winds, and the consequent diminution of the pressure which they occasion.

4th, "The greatest heights of the mercury are found upon easterly or north-easterly winds; other circumstances being alike." The reason of this may perhaps be, that when the winds blow from the eastern quarter of the heavens, they are (at least in this country) generally drier and less surcharged with vapour, than westerly or south-westerly winds, which, from passing over the immense expanse of water contained in the Atlantic ocean, must necessarily be loaded with more moisture.

5th, "In calm, frosty weather, the mercury generally stands high." The lower parts of the air being, in the time of frost, condensed by cold, must, of course, occasion a descent of the upper parts of the atmosphere to restore the equilibrium. There will, in these circumstances, be a rushing of the air from the surrounding parts of the atmosphere to fill up the vacuum, and hence the rising of the mercury in the tube may be accounted for.

W. S.

(To be continued.)

ON DYEING YELLOW.

The rapid progress of the science of chemistry, has made, of late, many valuable improvements in the art of dyeing; and till the former arrives at perfection, the improvements in the latter must daily increase. To show the dependence of this useful art upon that science, I beg leave to give one example; namely, the dyeing of a yellow on cotton by means of the chromate of lead.

The yarn to be dyed must first be boiled and prepared in the same manner as it is for dyeing any other colour; a quantity of the acetate, or nitrate of lead, is then dissolved and put into a vessel of a convenient size. The yarn is entered in this liquor and turned for a short time; it is then lifted and wrung. A quantity of the bi-chromate of potash is then dissolved in another tub, and the yarn entered and turned in it; a beautiful yellow is by this means produced, which, if not dark enough, must be wrung out of this tub, and again entered in the nitrate of lead, (I have supposed the nitrate of lead to be used;) then into the bi-chromate of potash, and so on till it is of the shade required; taking care to wring the one liquor out of it, before entering it into the other. The rationale of the process is simply this: The yarn in the first stage of the process being impregnated with the nitrate of lead, by entering it into the bi-chromate of potash, a change of principles instantly takes place; the nitric acid, having a greater affinity for the potash than for the lead, leaves the lead and combines with the potash, and forms a solvable salt, which remains in solution in the tub; while the chromic acid combines with the lead, and remains on the yarn to which it gives the colour.

13th April, 1824. A PRENTICE.

KNOX'S MONUMENT.

Mr. Editor,—From the interest employed, and the anxiety displayed, by some of our townsmen, for the erection of a Monument to the memory of our great reformer, Knox, I have no doubt but it will be accomplished, though I do, with many others, think it a thing quite unnecessary; for as long as the Protestant religion remains secure to us, it will be a never fading monument of his ability and perseverance in relieving us from the trammels of bigotry and superstition.

But, in the event of a monument being erected, it would be proper that a suitable situation be chosen, and that a design, plain, simple, and chaste, be adopted. I have no objections to urge against a Grecian Doric column, but let it be of the purest kind, without any paltry or unnecessary ornament.

The Greeks themselves seem to have been very sparing in external decoration, but to have united in their works, grandeur and simplicity; let then the proportion of this column be taken from the simple dignity of the Parthenon or the Doric portico of the Agora at Athens, or from some of the many Grecian examples, equally good; and let us throw away the frippery which appears in the anticipated design; and let the abacus and echinus assume the proper proportion equal to the strength of the column, and do away with the ridiculous idea of a pediment placed over one column, a thing in itself preposterous; and above all, let it be done in such a manner, that it may not bring on us the ridicule of strangers.

I am, Sir, your's,

Anthony Architrave.

CONSTRUCTION OF THE THERMOMETER.

(Continued from page 231.)

In constructing the thermometer, the first operation is to blow a hollow ball, or bulb of glass, to the extremity of a tube of very fine glass. The bulb, and part of the tube, is then filled with mercury. Now, as the capacity of the bulb is very considerable, with relation to the interior diameter of the tube, it is evident that a very small dilatation, in the volume of the mercury inclosed, will be exhibited in the tube by a considerable elongation of the fluid column. It is thus that very small variations of heat are rendered sensible; but the execution of this very simple idea requires several careful operations.

The first is to blow the bulb; this is done by melting the extremity of the tube, and rounding it with a piece of copper, or iron; then, by blowing with the mouth into the open extremity of the tube, this melted part is extended into a spherical ball. But the latter part of the operation has the inconvenience of introducing into the tube some humidity, which it is afterwards difficult to expel. Besides, it will be very difficult, in this way, to blow a bulb at the extremity of a very narrow tube. Instead of this mode, therefore, the open extremity of the tube may be introduced into the neck of a small bottle of caoutchouc, which should be well tied round it, so as to envelop it completely, and render it exactly air-tight. Then the other extremity of the tube being melted, and well rounded, the tube is to be raised in a vertical position, the cold part remaining below, and the bottle of caoutchouc pressed with the hand. The dry air which it

contains will have the effect of the blowing with the mouth; it will force the glass at the extremity to extend itself, and become round in the shape of a ball, without any of the former inconveniences.

To render the thermometer, however, always alike and constant in its indications, the tube must be of equal calibre throughout its whole length, so that the equal dilatations of the mercury in the bulb may be marked by equal increments in the height of the column. To make good thermometers, choice must therefore be made of those tubes of glass which approach the nearest to this equality. To try them, a drop of mercury is introduced, which being extended into the form of a cylinder, its length is measured. This cylindric portion of mercury being placed in different parts of the tube, and its volume remaining always the same, it ought, if the tube is of equal diameter throughout, to occupy an equal length in any part of the tube. As it is not easy to find tubes which satisfy this condition, and as it is almost impossible that they can fulfil it exactly, it is necessary, to attain perfect exactness, to correct the small inequalities which they present, by dividing them into portions of equal volume. Some precautions must also be taken in making the mercury pass into the bulb of the thermometer. As the tube by which it is introduced is generally very narrow, a considerable difficulty is experienced by the resistance of the air.

(To be continued.)

SOLUTION OF THE GEOMETRICAL PROBLEM.

Mr. Editor,—Referring your readers to Fig. 2, No. XIII., the problem may be solved in the following way. In the triangle A F D, are given all the angles, and the side A D; therefore, sin. A F D : sin. A D F :: A D : A F. In the triangle A B F, are given A F, A B, and the included angle F A B = the given angle F S D; whence the angle A B F, or its supplement A B S, will be found. In the triangle A S B, as sin. A S B : sin. A B S :: A B : A S; and, as sin. A S B : sin. S A B :: A B : S B. In the same manner will S D be found. Now, to find S P, and the chords A P and P D, bisect the chord A D in R, and draw R C to the centre C; join C B and C P.* Now, $\sqrt{CD^2 - RD^2} = CR$; and A R — A B = B R. In the right-angled triangle B R C, $\sqrt{CR^2 + BR^2} = CB$; whence the angle R B C will be found, and R B C + P B D (A B S) = P B C. Now, in the triangle P B C, are given P C, B C, and the angle P B C, whence B P may be found; and B P + B S = S P. In the triangle P S D, are given P S, S D, and the included angle P S D; whence the chord P D will be found. The chord A P may be found in the same manner, from the triangle A S P, or from the arch A P, which will be now evidently known.

The angle A B S, may be found in the following manner, without the former construction.—(See the original Fig. page 169.)—Let sin. A S B = a, sin. B S D = b, cosin. A S D = m, and sin. A B S = x. Then, sin. A S B : sin. A B S :: A B : A S, that is, $a : x :: c : \frac{cx}{a} =$ A S. And sin. B S D : sin. S B D :: B D : S D, that is, $b : x :: d : \frac{dx}{b} =$ S D. But, by trigonometry,

* These three lines are not drawn in the figure referred to, but they can be easily drawn with a fine pencil.

$$\left(\left(\frac{b^2 c^2 + a^2 d^2}{a^2 b^2}\right) - \frac{2 m c d}{a b}\right) x^2 = c^2 + 2 c d + d^2;$$

and, by reduction and multiplication, we have

$$(b^2 c^2 + a^2 d^2 - 2 a m b c d) x^2 = (c^2 + 2 c d + d^2) a^2 b^2;$$

whence, by evolution,

$$x = \frac{(c + d) a b}{\sqrt{b^2 c^2 + a^2 d^2 - 2 a m b c d}} = \text{sin. A B S.}$$

The angle A B S being thus determined, the chords A P, P D, and the line S P, may be easily found as before.

D. B.

Glasgow, March 29, 1824.

Equation.

$$\text{Given } x^2 - 1.8\, x y + y^2 = 4761$$
$$x^2 - 1.4\, x z + z^2 = 40401$$
$$y^2 - 1.\dot{1}\, y z + z^2 = 40000$$

To find the value of x, y, and z, by a simple equation, using only x, y, and z, in the operation.

J. N.

Glasgow, 21st April, 1824.

EASY RULE TO FIND THE WEIGHT OF CAST IRON BY MEASUREMENT.

A Correspondent requests an explanation of the reason of the following rule, which he finds of the greatest use in practice, and perfectly accurate for all ordinary purposes. To find the weight of any bar of cast iron, when the length, breadth, and thickness is given: *Multiply the breadth of the iron expressed in eighths of an inch, by the thickness expressed also in eighths, and take a half of the product, pointing off one figure in the quotient; the remaining figures of the quotient will be the weight of a foot of iron in pounds avoirdupois, which being multiplied by the number of feet in the length, will give the weight of the bar.*

Thus, suppose a bar of iron is 20 feet long, 3 inches broad, and $\frac{5}{8}$ of an inch thick; required its weight?

Here 3 in. $= \frac{24}{8}$, and $24 \times 5 =$ *120; now* $\frac{1}{2}$ of $120 = 60$, which *being pointed* is 6.0; hence the weight of one foot is 6 lbs., therefore the weight of the whole bar is $6 \times 20 = 120$ lbs.

To investigate this rule, let $m =$ the number of eighths of an inch in the breadth, $n =$ the number of eighths in the thickness, 12 inches $= 1$ foot, and $x =$ the number of cub. in. of cast iron in 1 lb. Then by the rule, $\frac{m n}{20} =$ the number of lbs. in a foot long. Now, $12 \times \frac{m}{8} \times \frac{n}{8} = \frac{3 m n}{16}$ the number of cubic inches in a foot long. Hence, $\frac{3 m n}{16} \times \frac{20}{m n} = x$; whence $x = \frac{15}{4} = 3.75$ the number of cubic inches of cast iron in a lb.

Now, $\frac{1728}{3.75} = 460.8$ the number of lbs. of cast iron in a cubic foot; and $460.8 \times 16 = 7372.8$ ozs. the specific gravity of cast iron, that of water being 1000. Thus we see

that the rule is founded on the assumption, that the specific gravity of cast iron is *exactly* 7372.8, as could be easily shown by synthesis after the above analysis.

We say this number has been assumed, because, according to most of the writers on specific gravity, that of cast iron is only 7200. According to Leslie, it is 7.21 or 7210; by Hutton, it is stated at 7207; and in the Edinburgh Encyclopædia, at 7.20 or 7200; Bonnycastle reckons it 7425, which is considerably above any of these, and is even greater than what was assumed.

If we take a mean between any of the former three, which are nearly the same, and that of Bonnycastle, we arrive at an expression for the specific gravity very near what has been assumed; for $\frac{7210 + 7425}{2} = 7317.5$; now $\frac{7317.5}{16} = 457.34375$; and $\frac{1728}{457.34375} = 3.778$ cubic inches nearly; this result differing so little from 3.75 or $3\frac{3}{4}$ cubic inches, it is evident that the latter may be assumed as a very near approximate value to the number of cubic inches of cast iron weighing one lb. Hence, it is on this circumstance that the rule is founded. For $12 \times \frac{n}{8} \times \frac{m}{8} + \frac{4}{15} = \frac{m\,n}{20}$ lbs. which is the rule, and it may be more shortly expressed in the following manner:

Divide the product of the breadth and thickness of the cast iron bar taken in eighths of an inch, by 20, the quotient is the weight of one foot; multiply this by the number of feet, and the product is the weight of the bar.

Similar approximate rules may be found for the other metals, but we leave their investigation to some of our ingenious Correspondents; and we would recommend these inquiries to their notice, as such results as we have obtained above must be of very great utility to the practical Mechanic.

SOLUTION OF THE STAIR QUESTION.

Mr. Editor,—The following is a solution of the question in your last, respecting the proportions in which the proprietors of a tenement ought to pay a common stair.

The whole stair may be considered as consisting of nine half parts; the upper proprietor, or C, having the entire use of $2\frac{1}{2}$, or $\frac{5}{9}$ of the whole, pays that fraction of £200, or £111 „ 2 „ $2\frac{1}{2}\ \frac{2}{3}$. The cost of each stair would be, if *equally* divided, £44 „ 8 „ $10\frac{1}{2}\ \frac{2}{3}$; but of *this sum*, which is the cost of B's stair, C ought to pay $\frac{5}{7}$, or £34 „ 14 „ $11\frac{0}{4}\ \frac{4}{21}$; B pays the remaining $\frac{2}{7}$, or £12 „ 13 „ $11\frac{1}{2}\ \frac{10}{21}$.

As to the first stair, it is manifest that *all* the proprietors ought to pay for its erection, since all have the use of it, though in very different proportions; for of its cost, C pays $\frac{5}{9}$, or £24 „ 13 „ $9\frac{3}{4}\ \frac{19}{27}$; B, $\frac{2}{9}$, or £9 „ 17 „ $6\frac{1}{4}\ \frac{13}{27}$. A pays the same as B, having an equal use of his own stair, that is, £9 „ 17 „ $6\frac{1}{4}\ \frac{13}{27}$. These shares collected into one view are as follows:—

A, pays for the first stair,..		£9 „ 17 „ $6\frac{1}{4}\ \frac{13}{27}$
B, pays for the second,.........................	£12 „ 13 „ $11\frac{1}{2}\ \frac{10}{21}$	
B, pays for the first,...........................	9 „ 17 „ $6\frac{1}{4}\ \frac{13}{27}$	
B, pays in all, ...		22 „ 11 „ $5\frac{3}{4}\ \frac{181}{189}$
C, pays for his $2\frac{1}{2}$ stairs,.........................	£111 „ 2 „ $2\frac{1}{2}\ \frac{2}{3}$	
C, pays for the second stair,....................	31 „ 14 „ $11\frac{0}{4}\ \frac{4}{21}$	
C, pays for the first stair, ...	24 „ 13 „ $9\frac{3}{4}\ \frac{19}{27}$	
C, pays in all,..		167 „ 10 „ $11\frac{1}{2}\ \frac{106}{189}$
Whole expense,..		£200 „ 0 „ 0 –

These are the due proportions which each ought to pay of the above £200, on the obviously equitable scale of the service, or perpetual servitude each has of the common stair, as the same principle will, or ought to be applied, in all after repairs.

I am, Sir, your's,

HUTCHESONUS FRATER.

Ingram-Street, 20th April, 1824.

Our venerable Correspondent has given, in our opinion, a very distinct and accurate solution of the above question; he might, however, have stated the exact fractional share of the whole £200, which each proprietor ought to pay; we supply the deficiency in the following manner:—

A's share,...... $= \frac{2}{9}$ of $\frac{2}{9} = \frac{4}{81}$ .... $= \frac{28}{567}$;

B's share,...... $= \frac{2}{9}$ of $\frac{2}{9} + \frac{2}{7}$ of $\frac{2}{9} = \frac{4}{81} + \frac{4}{63}$ .... $= \frac{64}{567}$;

C's share,...... $= \frac{5}{9} + \frac{5}{9}$ of $\frac{2}{9} + \frac{5}{7}$ of $\frac{2}{9} = \frac{5}{9} + \frac{10}{81} + \frac{10}{63} = \frac{475}{567}$;

Sum of the shares, ... $\frac{28}{567} + \frac{64}{567} + \frac{475}{567} = \frac{567}{567} = 1.$

Hence, A pays $\frac{28}{567}$ of £200, or £9 „ 17 „ $6\frac{1}{4}\ \frac{273}{567}$

B pays $\frac{64}{567}$ of £200, or £22 „ 11 „ $5\frac{3}{4}\ \frac{543}{567}$

C pays $\frac{475}{567}$ of £200, or £167 „ 10 „ $11\frac{1}{2}\ \frac{315}{567}$

Whole expense,......£200 „ 0 „ 0 „

REVIEW OF 'CRITICAL RESEARCHES IN GEOGRAPHY,'

pp. 202.—*James Brash & Co., Trongate, Glasgow.*

(Continued from page 253.)

AFTER establishing the superior accuracy of the Lamas' Map, in many points which were disputed by Du Perron, Rennel, and others, our author proceeds, in the following manner:—

"Before we close this discussion, a few remarks must be made respecting the Gangoutri, or Cow's Mouth, of the Hindoos. This appellation seems to be entirely mythological, as nothing has been seen at that celebrated place, or at the source of the river, that bears the least resemblance to the mouth of that animal, unless it be the great arch of snow that covers its source in the great snow-bed whence it originates, and which would require a great stretch of fancy to convert it into any thing nearly approaching such an appearance. The term signifies the sacred inclosure of the Ganga, or a sacred temple on the bank of the stream, beside a coond, or bason, formed by a recess of the river, where the pilgrims bathe, and pay their votive offerings to the river Deity. The Sanscrit appellation of the Cow's Mouth, is not Gangoutri, but Gao-muchee, and refers to an imaginary cavern, out of which the Ganges rushes into a large subjacent bason. Rennel, believing the actual *existence of* such a cavern, imagined it to be the mouth of the subterraneous aperture, made by the Ganges through the ridge of the Heemalleh. 'This great body of water,' says he, 'now forces a passage *through* the ridge of Mount Heemalleh, at the distance, possibly, of 100 miles below the place of its first approach to it, and, sapping its very foundation, rushes through a cavern, and precipitates itself into a vast bason, which it has worn in the rock, at the hither foot of the mountains. The Ganges thus appears, to incurious spectators, to derive its original springs from this chain of mountains.'

"This is a curious passage—the perforation of the Heemalleh by the waters of the Ganges. The Major, in consequence of this hypothesis respecting the long course of the river through Thibet, could make no other of it. Believing that the Heemalleh completely shut up Thibet from Hindoostan, and barred every avenue by which it could escape to the plains of India, he was compelled to adopt the hypothesis of making it force its way through the rocky barrier. Three things, respecting this wonderful operation, demand our attention, and it is wonderful that they did not occur to the mind of the Major, else, one would think, he would never have made such a strange hypothesis, and they would have

to suspect what he had hitherto respecting its long course through alpine country. The first thing nature of the rocky barrier itself, s not composed of soft slaty rock, at the falls of Niagara; or porestone, like that which composes er beds of the Kentucky—no; nite, the most compact of all anite. The second thing is, the of the base of this rocky barrier. eadth of the snowy chain itself, idently of the subjacent ridges n parallel with it, or project from is at least 40 miles in horizontal The third, and last thing is, e that would have elapsed before er could have accomplished such ndous perforation. To a theogeologist, time is no doubt an t of great consequence in his cals. Give him enough of that ard he will do wonders. Theorists stamp, deal with time as astrodo with space. They seem to it a *carte blanche,* to do with it as oose, and as it suits their conve- They seem to have considered bank on which they could draw nlimited amount, whenever their required it, and be furnished with ailing supplies. The time which er must have consumed in accom- this arduous work, though it not appal him, to us would appear atively incalculable. To say the uth, it appears to us a physical bility. No such perforation could ave been accomplished, and the , instead of forcing its way h the Heemalleh, or sapping its se, would have formed a lake. ppears to be the only consequence uld have resulted from such a state gs. We are certain that no such enon as that of a river perforat-whole range of mountains, occurs re. What is the reason that so akes exist in Thibet? No other want of outlets, and what takes ith so many rivers in that alpine would have taken place with the Ganges itself, if placed in similar circumstances. This theory of Rennel's, however, has nothing to do with the Lamas' map. These personages left the river to find its way in the usual manner; namely, by a pass, or gap, and never troubled their heads about a subterraneous perforation."—p. 137–140.

Our author then proceeds to expose the pretensions of the French and Germans, to the honour of the geographical discoveries of the British; the claims, particularly, which they make on behalf of Tiefenthaler, are completely disproved, and partly exposed in the following elegant passage:—

"We freely grant them the full benefit of a prior visit to that celebrated shrine of Hindoo worship, but we deny their conclusion; namely, that because he (Teifenthaler) visited that place, *ergo,* he visited the spring-head of the Ganges. The conclusion is illegitimate, being more than the premises will warrant. Do they believe, on Tiefenthaler's authority, that Gangoutri is the actual source of that stream? If they do, it proves both their own ignorance and that of their master. We must tell them, if they know not better, that Gangoutri is fully 11 miles, by the course of the stream, from the source of the river in the great snowy bed that conceals its infant waters; and we must tell them, farther, that till they can prove that Tiefenthaler not only visited Gangoutri, but traced the holy stream upwards to its source; actually visited its snow-covered streamlet; measured its breadth; ascertained its depth at the place where it first appears to the view of man; and kissed Mahadeva's icy locks;* they have neither part nor lot in the honours of that discovery." —p. 146.

* The Bramin who accompanied Hodgson to the place where the Ganges first emanates from under a snowy arch, imagined that the pendent icicles were the hairs of Mahadeva.

VARIOUS COMMUNICATIONS.

MAKE PHOSPHORUS.

Correspondent proposes the ing process, as much cheaper and better than that which was given in a former Number.

Take the leg-bones of horses and

calcine them until all the fat is burned away, and they appear friable, then pound and sift them through a fine sieve. To every pound of the powder add half a pound of acid of vitriol, and let the mixture stand for four days in a salted ware vessel, often stirring it up during that period. Then add water to it, and let it stand for twenty-four hours, then draw off the water with a glass syphon, taking care not to draw over the sediment; more water is to be poured on and drawn off alternately, several times, until all the free phosphoric acid be washed out, it is then to be evaporated into a thick extract. This extract is now to be put into a very large Stourbridge clay crucible, placed in a powerful air furnace, and melted into glass; it will froth up very much in this operation, but if it threatens to run over, stir it about with an iron rod, and when the glass has melted and ceased to bubble, pour it out on a clean stone, it will be of a fine citron-yellow colour, and will not diliquesce, on account of its containing some sulphate of lime. This glass is to be pounded and sifted, and half its weight of finely powdered charcoal mixed with it, and put into a retort of Stourbridge clay, only two-thirds filled. This charged retort is then to be coated with clay, and put into an air furnace, the neck being built close all round, and the beak allowed to project six inches; to this, a glass tubulated receiver, half-filled with water, must be luted, in such a manner, that when the phosphorus drops from the beak of the retort it will fall into the water of the receiver. The uncondensible phosphorated hydrogen gas will then rise up through the safety-tube of the receiver, and make its escape in a vessel of water placed at the lower end of the tube; great caution must be used at this part of the operation, as this gas takes soon as it escapes from the When no more phosphorus over, the whole apparatus m allowed to cool down to th perature of the atmosphere, the luting is taken off and admitted, otherwise it will t and burn. The phosphoru be moulded into sticks, by it in hot water in a glass funn a long tube corked at one en if stirred about, all the light i ties will rise to the top, an may be cut off when cold a again into the retort in th distillation.

Thus all the expense of acid and porcelain vessels dered unnecessary, as salte answers the purpose well e and they can be had of a lar and at a moderate expense, Manufactory near Port-Dun

In this way phosphoru easily be made; but still it is very expensive and tedious tion if made on a large sc requires both knowledge an terity in the manipulations other way of making it is, cure the residuum of the dis of urine from Mr. Mackinto cret Work, dissolving it in and pouring in the nitrate of long as there is any precip and distilling the precipita charcoal, as described in Twelfth Number.

I am, Mr. Editor,
Your most obedt.

Glasgow, 5th April, 1824.

ATTRACTION.

Mr. Editor,—The ot while rubbing out the penci in a piece of writing paper, piece of Indian rubber, I fo paper strongly attracted to t and, after heating the pap

electrical

found, on rubbing it a second that it was attracted in a still er manner. I also observed ome cuttings of the quill, lay on the table, adhered to per, even after it was raised nsiderable height above the —Now, if any of your learned pondents would have the ss to inform me what kind action this is, and what is the of it, he would much oblige tant reader.

J. V.

, 14th April, 1824.

ON METALS.

. Editor,—It is well known l metals expand when heated lted, and shrink or contract cooling; but that they lose g of their weight while cool- It is also known that iron, silver, &c. &c. swim on the of melted lead, but that gold on account of its greater . Now, Mr. Editor, if any r Correspondents would ex- the reason why cold iron, silver, or lead, after they are at an average of 1-8th of an o the foot, swim on the top same metals when melted; lso, why cast-iron cold, or in a melting state, swims on of melted cast-iron, they will ly add to the general mass of scientific knowledge, but they will much oblige

D. L. M.

Johnstone, 14th April, 1824.

EXPANSION.

J. C. wishes to know, on philosophical principles, the cause of the expansion of steel, on its being immersed in water at the common hardening temperature, when the contrary takes place with iron.

ON SOUNDINGS.

Mr. Editor,—In Number XV. J. P. gives a reason for soundings not being obtained beyond a certain depth, which is directly the reverse of that assigned by nautical men. It is well known, that at a certain depth in water, a line, with the lead attached, becomes specifically lighter than water, consequently will sink no farther, and even though at the bottom, if nearly in a state of equilibrium with the water, it will give no indication of it. J. P. may reconcile his assertion with the laws of Hydrostatics and experience of seamen as he can, but it is evident that it would require a very long line with an ordinary lead to break with its own weight though suspended in vacuo; but in water, it is the lighter the longer it is; as explained above.

G. M.

MISCELLANIES.

hinery for Calculating and Printing Mathematical Tables.

Babbage, Esq. F. R. S. L. & E.

(Continued from page 222.)

engine for computing tables by hod of differences, is the only one Mr. Babbage has yet completed, in his letter to Sir Humphrey onfined himself to a statement of ers which that method possesses; and as this statement is highly interesting, we shall give it in his own words:

"I would, however, premise, that if any one shall be of opinion, notwithstanding all the precautions I have taken, and means I have employed to guard against the occurrences of error, that it may still be possible for it to arise; the method of differences enables me to determine its existence. Thus, if proper numbers are placed at the outset in the

engine, and if it has composed a page of any kind of table, then, by comparing the last number it has set up with that number previously calculated, if they are found to agree, the whole page must be correct; should any disagreement occur, it would scarcely be worth the trouble of looking for its origin, as the shortest plan would be to make the engine re-calculate the whole page, and nothing would be lost but a few hours' labour of the moving power.

Of the variety of tables which such an engine could calculate, I shall mention but a few. The tables of powers and products, published at the expense of the Board of Longitude, and calculated by Dr. Hutton, were solely executed by the method of differences; and other tables of the roots of numbers have been calculated by the same gentleman on similar principles.

As it is not my intention, in the present instance, to enter into the theory of differences, a field far too wide for the limits of this letter, and which will, probably, be yet further extended, in consequence of the machinery I have contrived, I shall content myself with describing the course pursued in one of the most stupendous monuments of arithmetical calculation which the world has yet produced, and shall point out the mode in which it was conducted, and what share of mental labour would have been saved by the employment of such an engine as I have contrived.

The tables to which I allude are those calculated under the direction of M. Prony, by order of the French government; a work which will ever reflect the highest credit on the nation which patronised, and on the scientific men who executed it. The tables computed were the following:

1. The natural sines of each 10,000 of the quadrant, calculated to twenty-five figures, with seven or eight orders of differences.

2. The logarithmic sines of each 100,000 of the quadrant, calculated to fourteen decimals, with five orders of differences.

3. The logarithms of the ratios of the sines to their arcs of the first 5000 of the 100,000ths of the quadrant, calculated to fourteen decimals, with three orders of differences.

4. The logarithmic tangents corresponding to the logarithmic sines, calculated to the same extent.

5. The logarithms of the ratio tangents to their arcs, calculated same manner as the logarithms ratios of the sines to their arcs.

6. The logarithms of numbe 1 to 10,000, calculated to r decimals.

7. The logarithms of all n from 10,000 to 200,000, calcul fourteen figures, with five orders ferences.

Such are the tables which ha calculated, occupying, in their state, seventeen large folio volum will be observed, that the trigon cal tables are adapted to the deci tem, which has not been generally even by the French, and which l been at all employed in this c But, notwithstanding this objecti was the opinion entertained o value, that a distinguished men the English Board of Longitud not long since, commissioned by vernment to make a proposal Board of Longitude of France, t an abridgement of these tables, joint expense of the two countri £5000 was named as the sum vernment was willing to advance purpose. It is gratifying to reco disinterested offer, so far abov little jealousies which frequently fere between nations long riva manifesting so sincere a desire to useful to mankind the best mat science, in whatever country they be produced. Of the reasons w proposal was declined by our neig I am, at present, uninformed; bu a personal acquaintance with many distinguished foreigners to whom referred, I am convinced that it ceived with the same good feel those which dictated it.

I will now endeavour, shor state the manner in which this en mass of computation was execute table of which (that of the logarit numbers,) must contain about eig lions of figures.

"The calculators were divide three sections. The first sectio prised five or six mathematicians highest merit, amongst whom w Prony and M. Legendre. The occupied entirely with the analyti of the work; they investigated a termined on the formulæ to be em

"The second section consisted o or eight skilful calculators, hab

analytical and arithmetical com-ons. These received the formulæ the first section, converted them umbers, and furnished to the third the proper differences at the stated als.

y also received from that section culated results, and compared the ts, which were computed independ-for the purpose of verification.

e third section, on whom the aborious part of the operations de-, consisted of from sixty to eighty s, few of them possessing a know-of more than the first rules of etic, these received from the second certain numbers and differences, which, by additions and subtrac-in a prescribed period, they com-the whole of the tables above-oned.

ill now examine what portion of bour might be dispensed with, in it should be deemed advisable to ite these, or any similar tables of extent, by the aid of the engine I referred to.

the first place, the labour of the section would be considerably re-; because the formulæ used in the work I have been describing, have y been investigated and published. person, or, at the utmost, two, therefore conduct it.

the persons composing the second n, instead of delivering the numbers alculate to the computers of the section, were to deliver them engine, the whole of the remaining tions would be executed by machin-and it would only be necessary to y people to copy down as fast as were able the figures presented to by the engine. If, however, the ivances for printing were brought rfection and employed, even this r would be unnecessary, and a few intendents would manage the ma-, and receive the calculated pages in type. Thus, the number of lators employed, instead of amount-o ninety-six, would be reduced to re. This number might, however, onsiderably diminished; because, an engine is used, the intervals een the differences calculated by the d section may be greatly enlarged. he tables of logarithms, M. Prony ed the differences to be calculated at rvals of 200, in order to save the ir of the third section; but as that would now devolve on machinery, which would scarcely move the slower for its additional burden, the intervals might properly be enlarged to three or four times that quantity. This would cause a considerable diminution in the labour of the second section. If, to this diminution of mental labour, we add that which arises from the whole work of the compositor being executed by the machine, and the total suppression of that most annoying of all literary labour, the correction of the errors of the press, I think I am justified in presuming, that if engines were made purposely for this object, and were afterwards useless, the tables could be produced at a much cheaper rate; and of their superior accuracy there could be no doubt. Such engines would, however, be far from useless, containing within themselves the power ef generating, to an almost unlimited extent, tables whose accuracy would be unrivalled, at an expense comparatively moderate; they would become active agents in reducing the abstract inquiries of geometry to a form, and an arrangement adapted to the ordinary purposes of human society.

I should be unwilling to terminate this letter without noticing another class of tables of the greatest importance, almost the whole of which are capable of being calculated by the method of differences. I refer to all astronomical tables for determining the positions of the sun or planets. It is scarcely necessary to observe, that the constituent parts of these are of the form *a* sin. *o*, where *a* is a constant quantity, and *o* is what is usually called the argument. Viewed in this light, they differ but little from a table of sines, and, like it, may be computed by the method of differences.—*Ed. Phil. Jour.*

ITINERATING LIBRARIES.

We feel much pleasure in presenting our readers with the following extracts from the "Third Report of the East Lothian Itinerating Juvenile and Village Libraries." This mode of communicating knowledge is, in our opinion, calculated to be of very great advantage to the population of the various districts through which these Libraries pass, and must evidently excite a taste for reading and study among individuals who migh otherwise never have had an opportunity of obtaining useful information.

"The object of this Institution is to

furnish the Towns and the Villages of East Lothian with Libraries of useful Books, consisting of such as are calculated to promote the knowledge of Religion, Agriculture, Mechanics, the Construction of Implements of Husbandry, History, Travels, &c. The Books are arranged into divisions of fifty volumes, which are stationed in a place for two years, where they are issued gratuitously to all persons above twelve years of age who agree to take care of them; and after this period they are removed, or exchanged with other divisions.

Donations of Books on the above, or collateral subjects, or Subscriptions for the purchase of such Works, are earnestly requested, and will be applied to the specific objects for which they are destined. As this Institution affords the friends of the working classes an opportunity of diffusing amongst them knowledge of great importance to them, and which will ultimately turn to the benefit of their employers, from the superior manner in which a well-instructed workman will perform his work, and the possibility of fostering the genius of another Meikle* amongst us, perhaps the public-spirited Proprietors and Tenantry of East Lothian will not consider this Institution as unworthy of their patronage.

Those Societies, whose object it is to diffuse amongst the inhabitants of the country, generally, a knowledge of the improvements which have been made, or, what is of still greater importance, to excite them to make further improvements in Agriculture, the Arts, Manufactures, or Fisheries, may, by a Donation to this Institution, of a few Copies of such Works as are calculated to produce these effects, have them, very generally, circulated over the county of East Lothian.

The attention of those Authors who are anxious that their Works should be useful, is, most respectfully, called to this Institution, as affording them an opportunity of an extensive circulation of their Works through this county, by a Donation of a few Copies of their Publications.

Donations of the Reports of Benevolent Societies, and of such Religious Magazines as avoid discussions that are calculated to promote the peculiar sentiments of any Denomination of Christians amongst us, either in Volumes or in Numbers, will be very acceptable, and also the Farmer's Magazine, and the London or Glasgow Mechanics' Magazine.

" Donations of Books may be addressed to the Manager, to the care of Mr. David Brown, St. Andrew's-Street, Edinburgh; or the Depositaries of the Tract Society, London; the Book and Tract Society of Ireland, Dublin; and Mr. Ogle, Glasgow.

We are glad to understand that Mr. M'Fadyen is to deliver, on Monday evening, in the Hall of the New Institution, the same Lecture which was formerly reported in our Magazine, and which led to some considerable discussion respecting the theories broached upon the occasion. Our readers will now have an opportunity of judging for themselves, as we are informed he will abide by the same opinions which he at first entertained, though he intends to elucidate them more fully, which he is well able to do, not only from his extensive acquaintance with the recent theories relative to the Earth, but from his powers of elegant composition and of genuine and unaffected eloquence.

* Inventor of the Threshing-mill.

NOTICES TO CORRESPONDENTS.

The solutions of the Stair Question, by T. M. and 'Mechanicus,' Leith, were wrong, as they will see by the solution given in this Number. As several questions remain unsolved in the Magazine, which we have not leisure to solve, as we intended when they were inserted, we have come to the resolution of not admitting any more questions unless the proposers transmit solutions along with them; we trust, therefore, that our Correspondents will keep this in mind.—Our Correspondent, J. F. begs leave to state his question, p. 229, more correctly thus:—" If there be three given ports, B, C, and H, and from each of the ports, B, and C, a steam boat sails at the same time; that from B, in a given direction, ten miles an hour; in what direction and with what velocity must the other sail from C, so that they will always be seen from H, at the same angular distance, and should they at any time both tack and sail towards H, they will, at the same rate of sailing, both arrive at the same time? "

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J. CURLL, PRINTER.

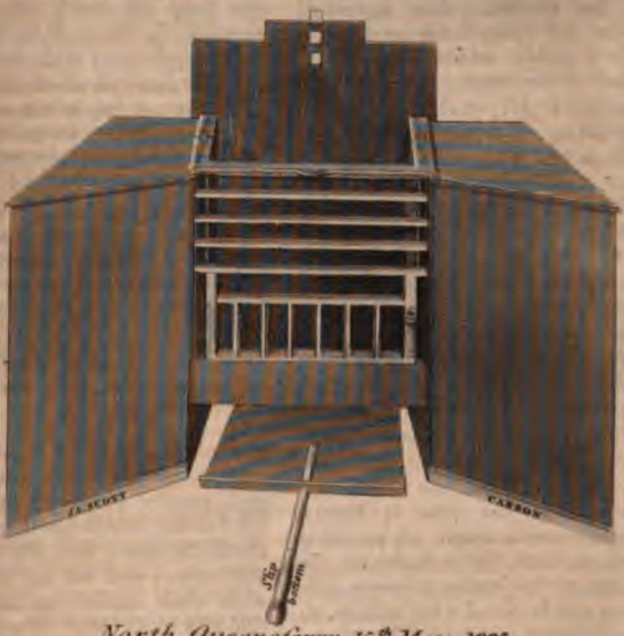
THE GLASGOW
MECHANICS' MAGAZINE.

" Rate not the extension of the human mind
By the plebeian standard of mankind,
But by the size of those gigantic few,
Whom Greece and Rome still offer to our view;
Or Britain well-deserving equal praise,
Parent of *Genius* too in better days.
Why should I try her num'rous sons to name
By verse, law, eloquence consigned to fame?
Or who have forc'd fair Science into sight
Long lost in darkness, and afraid of light.
O'er all superior, like the solar ray,
First Bacon usher'd in the dawning day,
And drove the mists of sophistry away;
Pervaded nature with amazing force,
Following experience still throughout his course,
And finishing at length his destin'd way,
To Newton he bequeathed the radiant lamp of day."—*Jennyns.*

No. XVIII. *Saturday,* 1*st May,* 1824. Price 3*d.*

JAMES SCOTT'S

SMOKE CONSUMING GRATE.



North Queensferry 15th May 1823

MR. SCOTTS' SMOKE CONSUMING GRATE.

(*Communicated by the Inventor.*)

This grate is an invention which has occupied Mr. Scott's leisure moments for some years, and is meant as an essay to improve the economy of dwelling-house fires, and a very laudable attempt towards arriving at a greater production of heat, of cleanliness, and of safety, and a saving of fuel.

The whole of the grate is shown in the engraving, except the counterpoise concealed by the hobs, and a *feather* cast longitudinally on the middle of each side of the *fire cradle*, which slides in a groove from the *hobs* downwards. The counterpoise is a weight of about 12 lbs. on each side, concealed under the hobs, hung by a chain over a pulley, and attached to the sides of the cradle. The person who uses this smoke consuming apparatus, must be also furnished with a prong key for opening the door of the grate.

The inventor having made use of this grate for three months, found it to answer exceeding well; he is, however, aware that improvements may be made in its construction. Indeed, he has since ordered some slight alterations at Carron, which he considers of some importance. He has caused the mould of the *front bars*, instead of being made flat, as they were originally, to be rounded on the inside, and those above the door to have a gentle curve forward. A mould is also prepared for a frame in the inside of the jambs, whereby this stove can be fitted with covings on the Register principle. The following directions were drawn up by the inventor.

DIRECTIONS FOR PLACING THE GRATE.

The builder, in fitting the stove into the fire-place, will please to let the extreme of the fronts be flush, or recessed about one inch within the common jambs, if there is depth, and filled and plastered close on each side, so as to exclude any current of air about the grate, except underneath, at the open space back of the ash-pit. *A plate of sheet iron* is then to be set perpendicularly on edge on the *hobs*, behind and close to the back, the ends reaching from one jamb to the other, coved if necessary, and joined and secured there, of the height of two or three inches above the lower part of the lintel, (having two holes previously cut opposite to those in the back, and another by the upper part of the back-plate, *turning over forward* this upper piece so cut only at the two sides and upper part, to secure this sheet of iron to the back-plate). The open space thus formed between this sheet of iron and the back wall will communicate with the before-mentioned opening underneath the grate, for the purpose of drawing inwards the dust and lighter ashes.

DIRECTIONS FOR MANAGING THE FIRE.

I.—*To make ready for a fire when the grate is empty.*

Let the larger coal be stowed in a loose manner at the bottom, and with smaller pieces on top, until filled to the *middle bar* immediately above the door; then the shavings and chips; and fill up the grate with clean cinders or half-burnt coal of a former day. When lighted in the middle, the *slip-bottom*, with the end of the handle resting on the hearth, may be erected, if necessary, on the fore-part, as an apron or blower, till the fire has kindled sufficiently.

II.—*When the fire is to be replenished with coals, (and this should be done before it is too weak.)*

With the common poker loosen the fire well, and stir the ashes out of the *bottom-grate* in the usual manner, till you have a *clear fire;* then, by the nob on the front, raise the upper or folding-bar with the point of the poker, inserting it upwards underneath this bar into the lower, second, and upper hole of the back-plate successively, as with a lifting lever, raising the cradle and *bottom-grate,* (assisted by the counterpoise,) until its surface is level with the upper part of the before-mentioned *middle bar,*—having the *key* at hand, insert the head into the *notch* of the slider, which will then appear close by the hob on the right hand side, to steady the cradle,—lay down the poker, and with both hands push in the *slip-bottom* close along the *bottom-grate,* and between it and the fire, until it find a rest on the back,—then remove the key, and ease or press down by the poker the bottom-grate and folding-bar to their places, (the fire being thus held suspended,) open the door of the grate with the key, *and having the coals ready,* the space below the *slip-bottom* may be quickly filled,—shut and secure the door and take out the key,—withdraw the slip-bottom and replace it on the hearth below the grate, (the live coals are then in contact with the upper part of the cold fuel,)—all which operations may be neatly done in one minute.

N. B.—It is ascertained, when *a clear fire* is replenished in this manner, that about three-fourths of the usual quantity of smoke is burnt in passing through it. Hence it is supposed, that with attention, a well going vent will not have occasion to be swept more than once in two or three years; and in course of time the *glossy heat* produced may ("like a blazing ingle,") get the appellation of a cheerful fire.

The *slip-bottom,* which is the only additional implement except the prong key, can be used as an apron, or blower, at any time, should the fire get weak, and by it the ashes may also be removed.

It is found conducive to much cleanliness, in all apartments where fires are used, to open the room door a little, so as to admit a steady current of air to the fire-place, before the *ashes* are disturbed, thereby preventing the circulation of dust.

JAMES SCOTT.

ON THE USE OF THE BAROMETER.

(Continued from page 261.)

6. "After very great storms of wind, when the mercury has been very low, it generally rises again very fast." The reason is, that the atmosphere being very much rarified by the great evacuations caused by such storms, the surrounding air rushes in with more rapidity, than at other times, to restore the equilibrium, *and by this the rapid rising of the mercury is occasioned.* Such *are a few of the most useful of the* results of Dr. Halley's observations upon the barometer, together with an abridged view of the manner in which he endeavours to account for them. The following rules for judging of the weather by the barometer, were written by Mr. Patrick, an author whose name is not so generally known as that of Dr. Halley, but who nevertheless seems to have been well acquainted with the subject. Mr. Patrick's rules will be

found still more useful than the former for practical purposes.

1. *Of the rising of the Mercury.*

"The rising of the mercury presages, in general, *fair weather*. In winter, it presages frost, and if the mercury rise, during the time of a continued frost, it presages snow. If the weather prove fair immediately after the rising of the mercury, its duration will be short. If the mercury rise much in *foul weather*, and before it is over, and continue so for two or three days, it presages a continuance of *fair weather*. In *serene, good, or calm frosty weather*, the mercury is generally high. The greatest heights of the mercury are found upon *easterly or north-easterly winds*. The mercury generally rises fast after great storms of wind, if it has been very low."

2. *Of the falling of the Mercury.*

"The falling of the mercury presages *foul weather*, as *rain* and *snow*, also *high winds* and *storms*. In very warm weather, the falling of the mercury indicates thunder. In frosty weather, if it fall three or four divisions, it *indicates thaw*. When foul weather happens soon after the falling of the mercury, it will not last long. In fair weather, when the mercury falls considerably, and continues to fall for two or three days before rain comes, a great deal of *wet weather* or *high winds* may be expected. The mercury is always low in calm weather when the air is inclined *to rain*. The mercury sinks lowest of all when *very high winds* occur. The unsettled motion of the mercury denotes *changeable weather*."

Such are Mr. Patrick's rules for judging of the weather by the barometer: they are unquestionably the best of the kind that have hitherto been submitted to the public. I have only farther to add respecting them, that I have repeatedly proved the accuracy of the greater part of these rules by actual observation. I now subjoin a few other rules of a more particular nature, drawn from a close and attentive observation of the barometer, and the subsequent changes of the weather in this neighbourhood.

1. In *winter*, *spring*, and *autumn*, a sudden and considerable falling of the mercury presages high *winds* and *storms*; but in summer *heavy showers*, and very often *thunder*. Although the mercury sinks low when there are high winds, yet this is more observable when the wind is accompanied with rain, than when either of them occurs separately. If after rain the wind change to any part of the north, and the sky becomes clear and free of clouds, and if these changes be accompanied with the rising of the mercury, fair weather will most certainly follow.

2. After a great storm of wind, or of wind and rain, &c. when the mercury has been low, it commonly rises very rapidly. In calm settled weather, although the mercury should sink a little, much rain ought not to be expected, for these slight depressions, in such a state of the weather, indicate only a little wind, or perhaps a gentle shower of rain, after which the mercury will again return to its former station. The truth of this observation I have seen repeatedly proved by the observations which I have made within the compass of these few weeks past. In a rainy season, particularly *in the time of hay-making*, and during *the period of harvest*, due attention should be paid to the slightest alterations of the mercury, for when the air is moist and much inclined to showers, it never stands very high, and even the fall of a single tenth of an inch will indicate more rain. In such a season, if the mercury rise suddenly to a great height, a continuance of fair weather, beyond a day or two, ought not to be expect-

ed; for, in most cases of this nature, it will fall as suddenly as it rose, till it return to its former station, and rain will immediately follow. If it rise slowly, however, for a day or two before a change to the better takes place in the weather, then it may be expected to remain fair for about a week.

3. In this country, the mercury will generally be found to rise highest during the prevalence of easterly or north-easterly winds. When the wind blows from these points of the compass, it may often be rain or snow, and very little alteration may take place in the barometer; nay, what is still more singular, it may even at that time be found that the mercury is rising. If the mercury, however, should fall when the wind is in that quarter, then it may be expected soon to change to another; and if the fall be great, a heavy rain is likely to ensue. In these rules and directions, no notice has been taken of the words usually engraven upon the scale of the barometer. The fact is, they are of very little use, as it will be but seldom that the weather will be found exactly to correspond with them. The rising and the falling of the mercury on the scale of inches ought to be the principal object of attention to every one who would make accurate observations. This will appear evident at once, when it is known that the height of the mercury in the tube is diminished in proportion to the number of feet above the level of the sea at which the barometer is placed.

W. S.

ON THE STEAM ENGINE.

Mr. Editor,—On looking into a work lately published under the title of a "Compendium of Mechanics," I observed some rules and observations worthy of animadversion, which I beg leave to notice through the medium of your columns. I consider it the more necessary to make the following remarks in your Magazine, as the work to which I refer is intended as a "Text-Book for Practical Mechanics," and it ought, therefore, to be as accurate, in all respects, as the nature of the subjects therein treated will admit.

1. In treating of the Steam Engine, the author, at page 100, states, "That water at the boiling point" produces steam "at the pressure of 15 lbs. on the square inch; but to allow for condensation and escapes, the safety-valve of a boiler is loaded, generally with 3 lbs. upon the square inch, which makes the pressure in the boiler 18 lbs. on the square inch of surface." And, again, at page 103, he states, "that the pressure of steam is 15 lbs. on every square inch of the cylinder." Now, Sir, as an inquirer, I wish to know what he means by "escapes and condensations." Does he mean to inform us that the steam condenses or escapes on its way to the steam cylinder? It seems, by this author's assertions, that the steam loses 3 lbs. in passing from the boiler to the cylinder, now, this is what puzzles me, for it is natural to suppose that when the steam is at the latter pressure, the steam-pipe, or boiler, would be at the same heat; for, as is the pressure of steam, so is the heat of the vessel containing it. Besides, I have seen the safety-valve placed on the steam-pipe, betwixt the boiler and the cylinder; surely then, if steam presses on the pipe at the rate of 18 lbs. to the square inch, it would naturally enter the cylinder with the same pressure; but, on the other hand, if the pressure is only 15 lbs. there is no need of a safety-valve, or pipe. He has, likewise, omit-

ted to mention whether he means Avoirdupois, or Troy weight.

The author has inserted a table, at page 102, showing the feet per minute at which an engine should travel, with the stroke specified. Now, he should really have omitted this table in his work, for, in the age in which we live, experience has shown that he is wrong in his statements. This table commences with an engine of two-feet stroke, travelling at the rate of 172 feet per minute, and making 43 strokes in the same time. Now, I have seen an engine of two-feet stroke making 50 strokes per minute, which is 200 feet of space per minute. It is unnecessary to extend my observation upon this table, as one example sufficiently indicates the inaccuracy of the rest. It may be observed, however, that those who have engines of five-feet stroke, should cause them to make 23 strokes per minute, and they will find more satisfaction in their working.

2. With regard to the cold-water pump, he states, at page 105, that "each horse power requires nearly $7\frac{1}{2}$ gallons per minute." Now, on this point, I would observe, that the author is also considerably mistaken; since at most $3\frac{1}{2}$ ale gallons per minute is only required for one horse power, as the following examples taken from actual practice will prove.

There is an engine at present working of 25 horse power, with a pump $8\frac{1}{4}$ inches in diameter; she has 19 inches of effective length of stroke, and makes 21 strokes per minute; required how many ale gallons she will draw per minute. First, $8.25^2 = 68.0625$; and $68.0625 \times .7854 = 53.4562$; now, 53.4562×19 inches $= 1015.669$ cubic inches; hence, $\frac{1015.669}{282} = 3.601$ ale gallons *each stroke*. Again, 3.601×21 strokes $= 75.621$ ale gallons per minute; and the engine being 25 horse power, we have $\frac{75.621}{25} =$ 3.02 ale gallons per minute for each horse power.

The same example may be performed according to a different mode, by the following Rule. *Square the diameter of the pump, multiply the product by the number of feet in the length of the stroke, and multiply the last product by the number of strokes per minute; then divide the whole by* 30 (one inch bore and 30 feet long being nearly an ale gallon) *the quotient is the number of gallons that the pump will raise per minute; then divide this quotient by the number of horse power, and the last quotient is the number of ale gallons that each horse power will require per minute.* This will be found to agree *nearly* with the former result.

First, $8.25^2 = 68.0625$; and $\frac{19}{12} = 1.58\dot{3}$ feet is the length of stroke. Hence, $68.0625 \times 1.58\dot{3} = 107.742$; and $107.7656 \times 21 = 2263.077$; therefore, $\frac{2263.077}{30} = 75.436$ ale gallons per minute; and $\frac{75.436}{25} = 3.017$ ale gallons per minute, required for each horse power.

This may be illustrated by another example, taken from practice. A 10 horse steam engine has a pump 5 inches in diameter, 12 inches stroke, and makes 40 strokes per minute; required the number of ale gallons it will draw per minute? First, $5^2 = 25$; and $25 \times .7854 = 19.635$; now, $19.635 \times 12 = 235.62$; hence, $\frac{235.62}{282} = .8355$ ale gallons each stroke. Therefore, $\frac{.8355 \times 40}{10} = 3.342$

ale gallons per minute for each horse power.

If the author of the "Text Book" means wine gallons instead of ale gallons, still the result will be very *considerably different* from his statement. For, taking the above example at this rate, we have $\frac{235.62}{231} = 1.02$ wine gallons each stroke. Hence, $\frac{1.02 \times 40}{10} = 4.08$ wine gallons per minute for each horse power.

The following example will show that the engine mentioned in the first example, would require a pump of 13 inches in diameter instead of $8\frac{1}{2}$, according to the "Compendium of Mechanics."

First, $13^2 = 169$; and $169 \times .7854 = 132.732$; hence, $132.732 \times 19 = 2521.919$; and $\frac{2521.919}{282} = 8.94$ ale gallons per stroke. Therefore, $8.94 \times 21 = 187.74$; and $\frac{187.74}{25} = 7.5$ ale gallons per minute for each horse power.

From these calculations it is evident, that if we were to follow the directions given in the Compendium, we would burden our engines with pumps. I may mention here that I have seen the injection-water so warm, that it would scald a person's hand above the cold-water pump cistern; in this case, however, the engine did not work steadily.

In conclusion, I beg to remark, that though there be passages in this work which are erroneous, and upon which I have thus animadverted, from a desire only to render the rules relating to the steam engine accurate, yet it contains many other valuable and incontrovertible rules selected from a great variety of authors, and calculated to be of great service to Mechanics.

M. S.

Glasgow, 26th April, 1824.

ATHENIAN TOWER AND CLEPSYDRA.

SIR,—The account given us, in a late Number of your Magazine, of some of the ancient Clepsydras, brought to my recollection one mentioned in Stewart's Antiquities of Athens, the remains of which stand on the Ilyssus, at the fountain Callirhoe, also called Enneacrunos, from its nine pipes. Perhaps some of your Correspondents may be able to give you an account of this Clepsydra which stood in a tower, as I quote only from memory. What took my attention most was the architectural beauty of the structure.

This building, which is highly decorated, stands in a principal part of the city, near the Agora, or market-place. It is built of fine marble. Vitruvius gives us the following description of it. Some have chosen (says he) to reckon only four winds, the east blowing from the equinoctial sun-rise, the south from the noon-day sun, the west from the equinoctial sun-setting, and the north from the polar stars; but those who are more exact, have reckoned eight winds, particularly Andronicus Cyrrhestes, who on this system erected an octagonal marble tower at Athens, and on every side of the octagon, he wrought a figure in relievo, representing the winds which blow against that side, whence it received the appellation of the Tower of the Winds. The top of this tower he finished with a conical marble, on which he placed a brazen triton, holding a wand in his right hand. The triton is so contrived that he turns round with the wind,

and always stops when he directly faces it, pointing, with his wand, over the figure of the wind at that time blowing.

This tower is covered with marble cut in the form of tyles. This appeared to the ancients so useful a piece of ingenuity, that they judged the author of it worthy of having his name recorded in an inscription, which secured to him the honour of this invention. Pausanias tells us that he was of Naxos, that his name was Byzes, and that he lived in the time when Alyattes reigned in Lydia, and Astyages, son of Cyaxares, reigned over the Medes, or about 580 years before the Christian era; which makes him contemporary with Solon the Athenian, and Tarquinus Priscus, King of the Romans.

This tower seems to have had two doors, or entrances, with porticoes, the capitals of the columns of which were of a peculiar form, different from the three established orders of Grecian architecture, but which, according to Stewart, had been in frequent use both at Athens and in other parts of Greece. The first specimen of this capital was introduced into practice in this city, in the portico of the house now occupied by Henry Monteith, Esq., M. P., in Buchanan-Street, which has been recently followed by three other examples in St. Vincent Street, with very peculiar effect. The columns of the original, however, were fluted and without bases.

It gives me great pleasure to see a taste for the arts displayed by our artists, in taking such beautiful specimens of ancient architecture for their models—for these precious remains of the Grecian art were long neglected; and, in fact, the most beautiful were nearly inaccessible to the Christian world. Athens still presents to the student the most faultless models of ornamental architecture, and is still therefore the best school for the acquisition of the higher attributes of his art. It is the more to be regretted, that the late and present commotions in that country is likely to dilapidate still farther the remains of this art, which were most worthy of being preserved.

I am, Sir, your's, &c.

CHRISTOPHER CAPITAL.

LIFE OF SIR ISAAC NEWTON.

It has been remarked, that the history of a great philosopher is best seen in his writings. A natural curiosity, however, still arises in the mind to know every thing that personally regards an eminent character. A separate department is thus opened to the biographer, in the details of his public and private life; his manners, his habits, and his occupations. Nor are these without their use, for they realize and embody the image in the mind, and give form and features to that *picture, which* would otherwise be too vague and abstract to be distinctly figured by the imagination.

If to both of these sources of rational interest, another should yet be added, and the labours and the life of an individual should be found to extend their influence, in a most sensible degree, to his age and country, the subject they present becomes altogether one of the most useful and engaging to the reader.

Of such a nature, in a pre-eminent degree, must be the life of Sir Isaac Newton, the most splendid genius that has yet adorned human

o has, by universal con- placed at the head of d who not only enlight- ind by his wonderful by his amiable qualities lessons which pointed to im even than his most scoveries.

born on Christmas-day,) 1642, at Woolsthorpe, ish of Colsterworth, in e, nearly three months ath of his father, who, o the general biography, nded from an ancient able family of the same The care of the young thus devolved upon his o, though she married me, gave him an excel- ion.

hile at school, he gave astonishing genius, and ised his acquaintances by ical contrivances. In- aying among other boys, busied himself in making and models of wood, of nds. For this purpose, he ttle saws, hatchets, ham- ll sorts of tools, which he to use with great dex- e even went so far as to wooden-clock. Having y seen a wind-mill, he it so attentively, as to o make a very perfect ich was considered at to the workmanship of l. This he sometimes on the top of the house dged, and having clothed s, he enjoyed the plea- ing it turn with the wind. nouse into this machine, called his *miller*, and he the mechanism so that would turn round the ever he thought proper. o joke too about the mil- the corn that was put ill.

Another of his contrivances was a water-clock, about four feet in height, and of a proportional breadth. There was a dial-plate at top, with figures for the hours. The index was turned by a piece of wood, which either fell or rose by the dropping of water.

These mechanical occupations sometimes engrossed so much of his attention, that he was apt to neglect his studies, and dull boys were now and then put over him in his class. But this made him only re-double his exertions to overtake them, and such was his capacity that he could do so with the greatest ease, and outstrip them whenever he pleased. He used himself to relate that he was very negligent at school, and very low in the class, till one day the boy above him gave him a kick, which put him to great pain. Not content with threshing his adversary, Isaac could not rest till he had got before him in the school, and from that time he continued rising until he was at the head of the class. Still no disappointments of this nature could induce him to lay aside his mechanical inventions; but during holidays, and every moment allotted to play, he employed himself in knocking and hammering in his lodging room, and pursuing the strong bent of his inclination, not only in things serious, but in ludicrous contrivances calculated to please his school-fellows as well as himself; as, for example, paper-kites, which he first introduced at Grantham, and of which he took pains to find out the proper proportion and figures, and the most suitable place for fixing the string. He made lanterns of crimpled paper, in which he placed a candle, and he used to go to school with them in winter mornings; he also used to tye them to the tail of his kite in dark nights, which at first fright-

ened the country people exceedingly, who took his candles for comets. He was no less diligent in observing the motion of the sun, and he drove pegs into the walls of the house where he lived, to mark the hours and half-hours by the shade. These, by some years' observations, he made so exact, that any body knew what o'clock it was by ISAAC'S DIAL, as it was usually called.

His turn for drawing, which he acquired without any instructions, was equally remarkable with his mechanical inventions. About this time, also, he constructed a cart with four wheels, in which he could drive himself by turning a windlass.

Upon the death of his step-father, he was removed from school by his mother, for the purpose of superintending and managing the farm at Woolsthorpe, but so little did his inclination agree with such concerns, that his principal employment and chief delight was to sit under a tree with a book in his hand, or to busy himself with his knife in cutting wood for models of any machine or curiosity that struck his fancy.

His mother observing this conduct, sent him again to Grantham School; after continuing there for a short period, he was entered at Trinity College, Cambridge, June 5, 1660, where he soon attracted the notice of Dr. Barrow, who perceived his talents, and contracted a great friendship for him. He soon made uncommon progress in his studies, always informing himself beforehand of the books which his teacher intended to read, and when he came to the lectures he generally found he knew more of the subject than the teacher himself.

Saunderson's Logic, Kepler's Optics, the Geometry of Descartes, and the Arithmetic of Infinites, by Dr. Wallis, were the first works which he read for this purpose. His neglect of the ancient Mathematicians, he afterwards regretted, on account of the wrong bias which the modern works he consulted gave his mind, and the want of that elegance of demonstration which he admired in the ancients.

The Elements of Euclid, and the works of the ancient Geometers, certainly appear to have occupied less of his attention than they were justly entitled to, from the manner in which he afterwards expressed himself to Dr. Pemberton. "I applied myself," said he, "to the works of Descartes and other Algebraical writings, before considering the Elements of Euclid with the attention which they deserved."

It was at this period that he invented the Method of Series and Fluxions, which he afterwards brought to perfection, though his claim to the discovery was unjustly contested by Leibnitz, who, by many, is supposed to have obtained a knowledge of it in 1676, from the author himself. At this time also, Mr. Newton took his degree of Bachelor of Arts, and about the same time he applied himself to the grinding of optic glasses for telescopes; and having procured a prism, for the purpose of examining experimentally Descartes's doctrine of colours, he soon satisfied himself of the fallacy of the hypothesis of that philosopher, and the result of his observations was his new theory of light and colours. Soon afterwards he drew up an account of his doctrine, which was published in the Philosophical Transactions, and unfortunately gave rise to a controversy between him and some foreign opticians, which produced an unhappy effect on his mind, and prevented him from publishing his mathematical and other discoveries, as he had originally in-

. He communicated them, er, to Dr. Barrow, who made known to the Members of the Society.

contemplating his genius, it es doubtful whether sagacity, ation, strength, or diligence, e greatest share in prompting coveries; and, after all, his stimation of it appears to be one, when he says, that, if done the world any service, due to nothing but industry tient thought; that he kept ject under consideration con- before him, and waited till t dawning opened gradually, e and little, into a full and ght.

fatigable in the pursuits of ; ever looking forward to new object of attainment; scovery was no sooner effect- n another was entered upon equal ardour and unabated erance. It seems, indeed, the natural consequence of ly engagement in the pursuits nce or of literature, that the once accustomed to a regular f thought, and to the exami- of a subject under all its nt aspects and relations, can- satisfied with a desultory e of its powers; and feels wonted self-enjoyment, with- determinate object of study stigation.

665, he retired to his estate ount of the plague appearing mbridge. During the two ne resided in the country, his was absorbed in philosophical ations; and it was in this ul seclusion that he received st idea of his system of gravi- and of the consequent dis- es which have elevated his above that of all other men, ed renown upon the country gave him birth. When sit- *one in his garden,* the acci-dental fall of an apple fixed his thoughts on this subject. At that time, not being in possession of any accurate measure of the earth's surface, he estimated the force of gravity erroneously, and found, in consequence, that it was not capable alone of retaining the moon in her orbit. This induced him to dismiss his hypothesis at that time as erroneous. But afterwards, when Picard had measured a degree of the earth's surface with tolerable accuracy, he was enabled to make a more precise estimate, and found that the force of gravity exactly accounted for the moon's motion in her orbit. He applied his doctrine to the planets and the whole solar system, and found it to account, in a satisfactory manner, for the whole phenomena of the motions of these bodies.

At various times after he procured his prism in 1664, Newton had directed his attention to the subject of optics. He began by grinding lenses in the form of some of the conic sections, with the view of correcting their spherical aberration, and in the belief that this was the only imperfection to which the telescope was liable. His success, however, did not equal his expectations, and he was led to study the nature of light itself, by repeating with his prism some of the experiments made by Grimaldi. The brilliancy of the prismatic colours struck him with surprise, and his attention was particularly fixed on the oblong figure of the spectrum. According to the received laws of refraction, the image of the sun ought to have been exactly circular, in place of an oblong form. This irregularity Newton at first supposed to be only accidental, and in attempting to find its cause, he was led to discover the compound or heterogeneous nature of colourless light, and to determine the different refrangibilities of the coloured rays

which entered into its composition. This important discovery explained to him at once the cause of the imperfections of refracting telescopes, and having computed the amount of the error arising from the different refrangibility of the rays of light, he found it to exceed some hundreds of times that which was occasioned by the spherical form of the lenses. By such steps, Newton was led to study the reflection of light, and he speedily saw, that by means of a reflecting material, capable of being polished as highly as glass, and having an exact parabolic form, he could construct a telescope free from all the errors produced by the compound nature of light.

On the return of Newton to the University in 1667, he was elected a Fellow of Trinity College, and took his degree of Master of Arts. Two years afterwards, he succeeded Dr. Barrow in the Mathematical Professorship, and was thus compelled to relinquish for some time his practical researches respecting the improvement of the telescope. Having resolved, however, to complete his optical inquiries, he made them the subject of his lectures during the first three years of his appointment, and had thus ample opportunities, not only of repeating his former experiments, but of re-considering his doctrine of colours, and bringing it into a systematic form.

He had not finished them in 1671, when he was chosen a Fellow of the Royal Society, to which learned body he communicated his theory of light and colours, which was followed by an account of a new telescope invented by him, and other interesting papers.

When the privileges of the University of Cambridge were attacked by James II., Mr. Newton was appointed to appear as one of her delegates in the High Commission Court, where he pleaded so strenuously, that the King, infatuated as he at this time was, thought proper to stop his proceedings. In 1696, he was made Warden of the Mint, and afterwards Master of that office; the duties of which situation he discharged with the greatest honour till his death. On his last promotion, he nominated Mr. Whiston, his Deputy Professor of Mathematics, at Cambridge, with all the emoluments, although he did not absolutely resign the professorship till 1703, in which year he was chosen President of the Royal Society, which honourable office he continued to fill till his death. He was knighted by Queen Anne, at Cambridge, in 1705.

In the succeeding reign he was very often at Court, and the Princess of Wales, afterwards Queen Caroline, frequently conversed with him on philosophical subjects; so highly indeed did she esteem him, that she was accustomed to congratulate herself that she lived in the same country, and, at the same time, with so illustrious a person.

Yet, notwithstanding the extraordinary honours that were paid him, he had so humble an opinion of himself, that he had no relish for the applause which he received. In Spence's anecdotes, we are told, that when Ramsay was one day complimenting him on his discoveries in philosophy, he answered, "Alas! I am only like a child picking up pebbles on the shore of the great ocean of truth." He was so little vain and desirous of glory from any of his works, that he would have let others run away with the credit of those inventions which have done so much honour to human nature, if his friends and countrymen had not been more jealous than he was of his own glory, and of the honour of his country. He was exceedingly courteous and affable even to the lowest, and never despised

any man for want of capacity; and he always freely expressed his resentment against immorality and impiety. He had such a mildness of temper, that a melancholy story would often draw tears from him, and he was exceedingly shocked at any act of cruelty to man or beast; mercy to both being a topic on which he loved to dwell. An innate modesty and simplicity showed itself in all his actions and expressions. His whole life was one continued series of labour, patience, charity, generosity, temperance, piety, goodness, and every other virtue without a mixture of any known vice whatsoever.

Fontenelle, after detailing these circumstances, observes, that "he was not distinguished from other men by any singularity, either natural or affected;" and Dr. Johnson considered it as an eminent instance of Newton's superiority to the rest of mankind, "that he was able to separate knowledge from those weaknesses by which knowledge is generally disgraced: that he was able to excel in science and wisdom, without purchasing them by the neglect of little things: and that he stood alone, merely because he had left the rest of mankind behind him, not because he deviated from the beaten track."

In the year 1722, after enjoying an uncommon share of health, owing to his activity and temperance, till he was fourscore years old, this great man began to be afflicted with an incontinence of urine, which was followed by the stone. The last twenty days of his life were attended with much pain, yet amidst the most severe agonies, though drops of sweat ran down his face with anguish, he never complained, or expressed the slightest sign of peevishness or impatience; and, during the short intervals from violent torture, would smile and talk with his usual cheerfulness and serenity.

He died on Monday, March 20, 1727, between one and two o'clock in the morning, having reached the advanced age of eighty-four years and a few months, and retained all his faculties and senses to the end of his life, strong, vigorous, and lively.

He was interred with great magnificence, and a splendid monument was erected to his memory at the public expense. D.

[*Some remarks on Sir I. Newton's philosophical discoveries will be given in our next Number.*]

PATENT POWER LOOM.

Sir,—Among the many subjects you have discussed, I was chiefly interested with the engraving and description of the patent loom, and I beg leave to offer the following remarks through the medium of your Magazine.

Mr. Buchanan has, beyond contradiction, made an important improvement on the common crank loom, by adopting the eccentric wheel and pinion, A and B, (see drawing No. 8, figure 2,) for regulating the motion of the lay, so as to allow time for the shuttle to clear the shed, before the lay comes forward near the fell of the cloth. Keeping the looms at the present speed, *viz.* 85 shots a minute, it will prove a great advantage, while, by working at 130 shots, the looms will cost double for tear and wear, the cloth will be worse, and if the yarn be inferior, or ill managed in the preparation, the web must be shifted into an easy going loom or be totally lost.

In the manufactory where I am

at present employed, we have looms wrought on various principles, and, except the crank looms, the lays have all a rest, when the shuttle goes across the web, equal to the rest of the lay on the patent loom.. About three years ago, we raised the speed on a few of our looms, to 115 shots; but after a trial of some months, we found the effects mentioned above more than counterbalance any advantage gained by the speed. Every operative weaver knows, that, by driving his shuttle at a regular easy speed, he will produce more cloth, and a better fabric, than by working one-fourth or one-third faster; the principle is the same in the power loom.

Upon reading Mr. Buchanan's statement, a manufacturer, who has but a superficial knowledge of weaving, will make a calculation; if 85 shots produces a certain quantity of cloth in a given time, how much will 130 shots produce? he will adopt the patent loom; and when the quantity woven, does not meet his expectation, he will naturally conclude that his workers are deficient in ability.

The above observations may serve to correct this misapprehension. It is easy to put speed on a power loom; but if Mr. Buchanan directs his attention to the improvement of the looms, so as to be easier on the yarn, and thereby enable them to work finer fabrics than has been hitherto done, he will benefit the trade more than what a short experience will show the patent loom can effect.

I am, Sir,
Your's, &c.
A Power-Loom Tenter.

Glasgow, April, 1824.

SOLUTIONS AND QUERIES.

A country Correspondent gives the following solution of the question relating to the point of meeting, proposed at page 244.

The point of meeting for A $=1+2+3+4=$ 10 miles, after 1 revolution.
" " " B$=1+4+9+16=$30 miles, after 3 revolutions.
" " " C$=1+8+27+64=$100 miles, after 10 rev.

Thus, it appears, they all meet at the place of first outset at the end of the fourth day; A having travelled 10 miles, B 30, and C 100 miles. The question is in the simplest state of the case; but had the island been 19 miles in circumference instead of 10, I should gladly give a bottle of Port to the proposer for a solution.*

I consider very deep and intricate questions as quite discouraging to persons of *moderate capacity;* and calculated to destroy any laudable ambition for improving the mind in mathematical or mechanical studies; for which reason, there might be a few simpler queries inserted now and then in your excellent Magazine; for by solving such, we proceed with vigour to the consideration of every new case where there is some hope of success, and are thus led on, step by step, until we solve those of the more abstruse kind.

1. In a common clock, the hour and minute hands form a right angle at 9 o'clock; when will the hands be at right angles again for the 16th time after 9?

2. A rectangular board is 3 feet 4 inches long, 18 inches broad at

* *We hope the proposer will accept the offer.*

ie end, and 10 inches at the where ought this board to that a piece taken out of it, es in length may just be a foot?

RUSTICUS.

are of the same opinion as icus' with regard to "deep tricate questions," and we con- that easy and practical ques- in the application of mathe- s to mechanical problems are of more importance. We see no harm, however, in inserting, occasionally, a difficult question, for the purpose of exercising the skill of some of our learned and witty Correspondents, who are pleased with nothing but what is above the ordinary comprehension of our readers. It is our wish to please all, but we must not indulge one set of readers at the expense of displeasing another. We shall, therefore, only insert such questions as we conceive are of the greatest utility to practical mechanics.

PERIODICALS, &c.

is the age of cheap periodi- Never was there, at any l of history, such a general ion of knowledge over the lom as there is at this moment. ave Magazines, Journals, and ttes in overflowing abundance. would think that every class of ty, and every grade of every high and low, rich and poor, ed and unlearned, has its own iar Magazine. We rejoice at diffusion; it is a spectacle ny of the reflections of the phi- ropic mind. Every person has pecies of knowledge he wants, e is happy. Such are the in- lable blessings of the art of ing. Within two centuries it oubled the faculties of the race. n this progressive improvement ankind will reach a maximum, mpossible to anticipate, but it surely have its limits. This is state of perfection, and there- such is our conclusion.

e question, however, if, after he most important and useful hes of knowledge are duly at- d to, or properly studied. e is an immense bustle and n the literary world, a noisy g and writing about matters, *are in themselves of* very little importance to the mass of mankind. A skimming on the surface, instead of a searching to the bottom of subjects, seems to be the rage of the writers and readers of the present day. Amid all this bustle, we are glad to see the older works still keeping up their reputation and utility amongst this reading generation. The publication of such valuable works as Hume and Smollet's Histories of England; the Roman History from its Origin to its Decline and Fall, &c. &c. in twopenny weekly numbers, is, in our opinion calculated to do more good among the lower classes of society, than a great deal of the other threepenny, twopenny, and penny weekly publications which issue from the press, always, of course, excepting those which contain science. In the latter, we find occasionally a delightful passage, or an interesting tale, amid a heap of trash of poetry or wonderful stories which nobody believes; whereas in the former, we always find the masterly delineations of the historian inciting us to virtue, or deterring us from vice. We see the ennobling rewards conferred on the upright and courageous man, and the degrading punishment allotted to the ambitious and dastardly slave

of his passions, pourtrayed in the most glowing colours of his rich and exalted genius. Such works will ever instruct and charm, when the present age of drivelling has passed away. We would recommend this edition of the histories alluded to,* as the cheapest and best that ever was published; it is enriched with the most exquisite wood engravings we have yet seen, illustrative of the various characters and noble actions that adorn the pages of the work. The questions upon history are selected and arranged in a manner admirably well calculated to draw the attention of the young reader to the most important facts, and the references to the pages and columns of this edition for the answers, are the most complete that could be imagined. We shall select only two examples:—

"814. When and where did Magna Charta receive the royal signature?—Page 238, col. 2, par. 3.

"A conference between the king and the barons was appointed at Runnemede, between Windsor and Staines; a place which has ever since been extremely celebrated, on account of this great event. The two parties encamped apart, like open enemies; and, after a debate of a few days, the king, (John) with a facility somewhat suspicious, signed and sealed the charter which was required of him (June 19, 1215.) This famous deed, commonly called the Great Charter, either granted, or secured very important liberties and privileges to every order of men in the kingdom; to the clergy, to the barons, and to the people."

"816. Enumerate the chief clauses of Magna Charta.—Page 239, col. 2, par. 2.

"It was ordained, that all the privileges and immunities granted to the barons against the king, should be extended by the barons to their inferior vassals. The king bound himself not to grant any writ, empowering a baron to levy aid from his vassals, except in three feudal cases. One weight and one measure shall be established throughout the kingdom. Merchants shall be allowed to transact all business, without being exposed to any arbitrary tolls and impositions; they and all freemen shall be allowed to go out of the kingdom and return to it at pleasure; London, and all cities and burghs, shall preserve their ancient liberties, immunities, and free customs; aids shall not be required of them but by the consent of the great council; no towns or individuals shall be obliged to make or support bridges but by ancient custom; the goods of every freeman shall be disposed of according to his will; if he die intestate, his heirs shall succeed to them. No officer of the crown shall take any horses, carts, or wood, without the consent of the owner. The king's court of justice shall be stationary, and shall no longer follow his person; they shall be open to every one; and justice shall no longer be sold, refused, or delayed by them. Circuits shall be regularly held every year; the inferior tribunals of justice, the county court, sheriff's turn, and court-leet, shall meet at their appointed time and place; the sheriffs shall be incapacitated to hold pleas of the crown; and shall not put any person upon his trial from rumour or suspicion alone, but upon the evidence of lawful witnesses. No freeman shall be taken, or imprisoned, or dispossessed of his free tenement and liberties, or outlawed, or banished, or anywise hurt or injured, unless by the legal judgment of his peers, or by the law of the land; and all who suffered otherwise in this, or the two former reigns, shall be restored to their rights and possessions. Every freeman shall be fined in proportion to his fault; and no fine shall be levied on him to his utter ruin; even a villain, or rustic, shall not, by any fine, be bereaved of his carts, ploughs, and implements of husbandry. This was the only article calculated for the interests of this body of men, probably at that time the most numerous in the kingdom."

* Dolby's Universal Histories.

Aberdeen Mechanics' Institution.

The Aberdeen Mechanics' Institution has at length been set a-going. Intelligent Lecturers have been appointed, and on Monday week they commenced operations by delivering their Introductory Lecture. The Hall is both elegant and commodious, and every way well adapted for the purpose. Upwards of 500 students have already joined this Institution. So much for the march of science!

NOTICES TO CORRESPONDENTS.

We request our Correspondent C. or T. G. Paisley, to adopt always the same signature, to prevent confusion; his last communication is very ingenious, but we must revise it; we wish he would bestow more attention on his composition, &c.—U. S. C. and B. T. cannot be inserted, as their communications are now of no importance.—"One of the Cyclops" is informed, that W. T. is as little known to us as he is, and therefore he must in future be *sure* of the *value* of his communication before he again puts us to the same expense.—"Joachim and Boaz" is too long and indistinct.—Y. is partly superseded.—I. D. C., J. F., C., J. H., J. P., M. W., and a Student of Chemistry, under consideration.—R. B. must send *his* solution.—M. A., C., J. P., and D. B., will be inserted next week.—W. C., Paisley, has not been forgotten; we shall notice his communications in our next.

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J. CURLL, PRINTER.

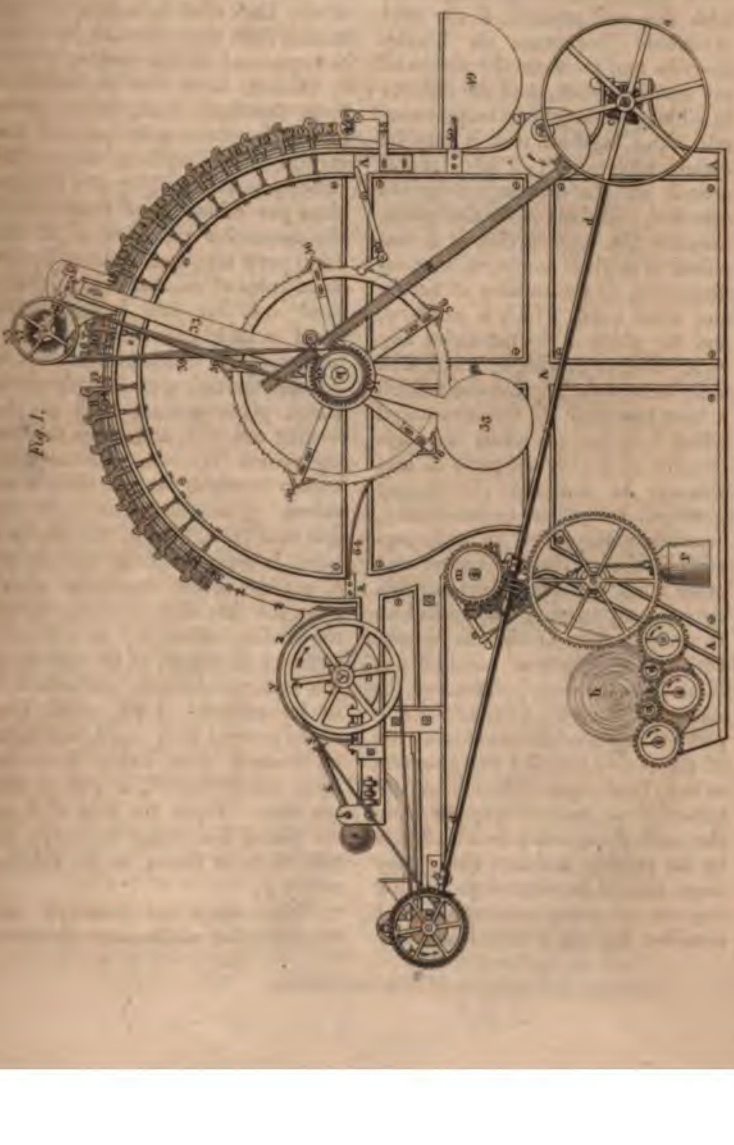
THE GLASGOW

MECHANICS' MAGAZINE.

> "Favoured of God, here Newton saw
> Errors obscuring nature's law;
> He saw, and cleared the gloomy way,
> And showed mankind eternal day;
> He showed, and worlds beheld with joy,
> Labours which distant time, nor envy shall destroy."—*Schomberg.*

No. XIX. *Saturday, 8th May,* 1824. Price 3*d.*

Mr. BUCHANAN'S PATENT CARDING MACHINERY.



Mr. BUCHANAN'S PATENT CARDING MACHINERY.

Specification by Archd. Buchanan, *Esq. of Catrine Cotton Works, one of the Partners of the House of James Finlay & Co. Merchants in Glasgow, relative to his Patent for an improvement in Machinery, heretofore employed in Spinning-mills in the Carding of Cotton and other Wool, whereby the Top Cards are regularly stripped and kept clean by the machinery, without the agency of hand-labour.*

Now know ye, that in compliance with the said proviso, I the said Archibald Buchanan, do hereby describe and ascertain the nature of my said invention, and the manner in which the same may be performed. And in order that it may be clearly understood, I have represented on the drawings hereunto attached, and shall, in the first place, describe the construction of a machine, or engine, employed in spinning-mills, in the carding of cotton and other wool, which is not new, and for which I do not claim any right, title, or privilege; and I shall then describe the improvement which I have invented on the same, and which I declare to consist in a combination of the several parts of machinery, or materials hereinafter specified, as applied to machinery, heretofore employed in spinning-mills in the carding of cotton and other wool, whereby the top cards are regularly stripped and kept clean by the operation of the machinery, without the agency of hand-labour. It may be necessary, however, to state, that though I do not claim any part of the materials or construction of the engine which I first describe as new, this engine differs in its construction in various respects from the carding engines presently in use by the public; and that though my improvement is adapted to carding engines of every construction, I consider the one which I am now to describe, as best fitted for its application.

The various parts of this engine are distinguished on all the drawings and figures to which I refer, by the same alphabetical letters, and the references which follow, are to be found in fig. 1. Profile elevation right hand. The framing of cast iron is at A A A, &c. *a a* are the fast and loose pullies upon the end of the back shaft *b*, which receive motion from the mill-work by a belt or strap, and set the carding engine in motion, or at rest as required. *b*, is the back shaft, which gives motion to all the other parts of the carding engine on both sides. Its velocity is about eighty-five revolutions per minute, and from which the respective velocities of all the other parts may be calculated by the usual rules of mechanical computation. *c c*, are two bevel wheels, equal in their diameters and numbers of teeth, which give motion to the side shaft *d*. *d d*, the side shaft, which gives motion both to the feeding rollers J, and to the delivering rollers W. *e e*, bearers with bushes in which the side shaft *d* revolves. *f*, coupling box upon the side shaft, *d d*, which, for convenience, is constructed in two pieces. *g*, endless screw, worm, or spiral, upon the side shaft *d*, which moves the feeding rollers J. *h*, roll-web, or fleece of cotton, as brought from the picking machine, and which is to be carded. I I I, small iron shafts covered with wood, and turned to about three inches diameter, upon which the roll, or web of cotton rests. Upon the first of these are placed four straps to convey the roll, web, or fleece, to the feeding rollers J.

These straps are returned over another roller of the same diameter.

so fig. 2.)* J J J J, are the
; rollers. K, is a flanche of
o keep the cotton roll, web, or
n its proper place, and to pre-
from diverging laterally upon
side. *l l l l*, are stud wheels
ey motion from the feeding
J, to the three rollers *i i i*,
give motion to the cotton at
is a screw wheel fixed upon
d of the feeding rollers J.
are the lever, chain, and
, which keep down the top,
er feeding rollers.—(See also
r referred to.) *q q*, the axis
rcumference of the main cy-
which is about 42 inches
er. Upon this cylindrical
ference, sheet cards are fixed,
in revolving, carry the cotton
he feeding rollers under the
ds, No. 1, to 20, inclusive,
eliver it upon the front, or
cylinder *y*. *y y*, the axis
rcumference of the doffing
r, which is about 12 inches
er upon its circumference,
r spiral cards are fixed to re-
he cotton from the main cy-
q. *s s s*, are the comb, its
and the balance weights of
ter-off, vibrating upon its cen-
t. *u u*, are the pinching
which regulate the action of
o cylinders upon each other
point of contact. One screw
t-handed, and the other left-
l, for facility of setting the
rs properly. V V, the pinion
heel which communicate mo-
om the side shaft *d*, to the
ing rollers W W. W W, the
ing shaft and top roller. X,
lley upon the delivering shaft,
hich gives motion to the dof-
linder Y, by the band and
also marked Y. Z Z Z, is a
f curved sheet iron, hinged
to a strap of cast iron, stretching across the framing, in front of the top card, No. 1, which serves as a guard to prevent any substance from falling between the cylinders and injuring the cards.

The references which follow are to fig. 2. Left-hand elevation. B, is a pulley of 12 inches diameter, giving motion to the large cylinder *q*, by means of the belt *c c*. D, the pulley on the large cylinder, which receives the motion communicated by the belt *c c*. E, another pulley attached to the arms of the pulley D, for driving the crank which moves the comb. F, pulley upon the crank shaft, which receives the motion from E, by means of the belt, L L. G G, bevel wheels of equal numbers of teeth, which convey motion from the delivering shaft *w w*, to the conducting rollers H H. I, the cann which receives the carded cotton sliver, when conducted between the delivering rollers H H, to the left-hand side of the machine. K, a pulley loose upon its axis for conducting the chain of the weight P, which keeps down the upper feeding rollers.—(See *n o p*, before referred to.) T T T, No. 1, to 20, inclusive, are the top cards, each of which turns upon hinges to admit of its being freely and quickly turned over, so that the side upon which the card is fixed, may be exposed to the operation of the machinery, to be after described, whereby they are "regularly stripped and kept clean," and also to allow them to be returned into their working positions after being so stripped and cleaned.

Having thus described the construction of an engine, or machine, for carding cotton and other wool, at present in use by myself, and which I consider best adapted for the application of my invention; but for which I do not claim any right of Patent; I now proceed to describe my said improvement, and to

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is figure, which is another view
achine, will be given in our next
r.

exhibit the application of the same to the said engine, for the purpose of more distinctly illustrating its application to carding machinery of every construction. And, whereas, the separate parts of the machinery, or materials after specified, are not new, therefore I claim no right, title, or privilege, to any part thereof, as my invention, but to a combination of the whole, as applied in manner after described, to machinery heretofore employed in spi mills, in the carding of cotto other wool, whereby the top are regularly stripped and kep by the operation of the macl without the agency of hand-l and which combination so a is, to the best of my knowled tirely new, and has never be fore used in these kingdoms.

(To be continued.)

ON A NEW AND IMPOVED PROCESS FOR SINGEIN MUSLINS.

Sir,—I had an opportunity, the other day, of seeing a process for singeing muslins with the flame from the coal gas, which is so plentifully distributed through our *enlightened* city, and I have no hesitation in saying that it possesses considerable advantages over the common method by the heated cylinder. It is simply this: The gas is conveyed into a pipe whose length is rather greater than the breadth of the muslin, say five feet; the diameter is 1½ inches, and it is pierced full of small holes of nearly the same size as those of the single jets of the Glasgow Gas Company. The pipe is fixed in a frame, and there is attached to the frame an apparatus of the same kind as that used on the old plan, *viz.* rollers and guiding rods.

The cloth is passed over the flame of the gas at the distance of about an inch and a half; (this distance must, however, be regulated by the quality of the cloth;) the flame, being about four inches high, is pressed down by the cloth, so near the pipe, that it spread in a sheet, and passes up t the body of the cloth, con the fibres of the cloth both nally and internally.

The superiority of the ne over the old, consists in thi the fibres in the body of the as well as on the external s are consumed; whereas, on plan, the external fibres only be consumed. How far this tage operates in favour of the when brought to market, the facturer is sufficiently aware out my enlarging upon it any

I am not aware of a patent been taken out for this new p although the person who has ed it, hints, in a mysterious n of such a bugbear being in h session. Perhaps you, Sir, o of your Correspondents, v able to inform me whether o patent has been taken out f process.

I am, Sir, your's, &c

ON THE EXPANSION OF METALS.

Sir,—To answer D. L. M.'s *queries* satisfactorily, would require a series of experiments, an sorry that at present I have

per opportunity of making them; I shall therefore only hazard a few remarks, if you think them worthy of insertion, they may perhaps give D. L. M. some new light on the subject.

In the first place, there are very few metals so pure that they do not lose some weight in cooling, after having been heated red-hot, or melted. I am not aware of the degree of heat requisite to produce the maximum expansion of iron, I should, however, consider it far below the temperature of melted metals. Suppose a piece of iron were thrown into a furnace containing metal in a state of fusion, the scoriœ, or scum, always found on the surface, would counterbalance the difference, in specific gravity, between the melted metal and that thrown into it, until by expansion it acquired the same specific gravity with that in the furnace; which, I am convinced, would take place in a very short time, and when it had attained the same specific gravity it would continue on the surface until it united with the melted mass. It is a well known fact, that there is a repulsion between water and most substances brought into contact with it; for example, take a small sewing needle, make it very dry, and put it gently on the surface of a tumbler full of water; if neatly done, the needle will float, notwithstanding the great difference of specific gravity; and there will be an evident repulsion between the needle and the water. The experiment may be rendered more interesting by magnetizing the needle; it will then act as a mariner's compass, and may be attracted from one side of the tumbler to the other, by means of a piece of iron, or steel: it does not, however, move *through* the water, a portion of the water surrounding the trough, (if I may be allowed the term,) in which the needle lies, moves along with it. Now, the same repulsion will exist between melted and unmelted iron, even in a stronger degree; and, when we take into consideration the barrier interposed betwixt them by the dross and other extraneous matter of very small specific gravity in comparison with iron, always found floating on the surface of metal in a state of fusion, D. L. M. will perceive that the apparent anomaly is not so difficult to reconcile as might appear on a cursory examination.

The subject affords a field for some very interesting experiments, and I regret much that I am not in a situation to try a few of them; they will be rather difficult, I apprehend, as it is very rare to find two pieces of metal of the same specific gravity; a piece cut off one end of a bar, and a piece cut off the opposite extremity, will sometimes differ very considerably. With regard to J. C.'s query respecting steel, I rather think that he is under a mistake. I know that when mixed with a *very small* portion of iron, it *contracts* on being cooled. Would J. C. be so good as to specify the proportion of expansion it undergoes in cooling. If it does contract, I should attribute the contraction to the different arrangement of crystallization which takes place in hardening it.

Query.—Upon holding a shell, with spherical evolutions, to the ear, a faint rumbling noise is heard, would some of your Philosophical readers be so obliging as to assign a cause for it? I have formed an opinion on the subject, but should be glad to have another, as two heads are reckoned better than one.

I am, Sir,

A Constant Reader,

Y.

ON INTOXICATING GAS.

SIR,—Having lately witnessed the effects of the protoxide of azote on a person in the Mechanics' Class, I was induced to make a few experiments with it; and as nothing on this subject has as yet appeared in your Magazine, although, probably, most of your readers are already acquainted with it, yet for the information of those who may be ignorant of it, I have taken the liberty of sending you a statement of the results.

As nitrate of ammonia is the salt from which this gas is most easily obtained, and as it cannot be met with in commerce in the dry state, it is first necessary to prepare it, which is easily done, by saturating carbonate of ammonia with nitric acid, and causing the solution thus formed to be evaporated to dryness.

To collect the gas in any quantity for respiration, a bladder must previously be procured, (the larger it is the better,) having a glass tube firmly attached to the mouth of it; for easy respiration, the tube should be from a half to three quarters of an inch in diameter, and the bladder moistened before use, to render it more flexible.

A retort is now to be charged with the dry salt, formed as above, and a moderate heat applied. At first a gas comes over, which, being very impure, must be allowed to escape; the best criterion to judge of its purity is, that the retort becomes filled with white fumes, and a gas is evolved, into which, if a lighted taper be introduced, the brilliancy of the combustion equals that of a taper introduced into pure oxygen; this is the pure protoxide of azote, which may now be collected for experiment.

The bladder being filled, and the *end of the tube* tightly stopped, to *experience its effects* the end of the tube must be introduced into the mouth, having exhausted the lungs, and closed the nostrils; then the contained gas must be breathed from and into the bladder, taking care that the mouth is completely closed on the tube, as the admission of air, owing to the mouth being partially open, may prevent the complete success of the experiment.

In every case, I found two minutes quite sufficient to breathe it; indeed, one minute rendered some individuals quite insensible and incapable of voluntary action. The first feeling is giddiness, and a thrilling through the whole body, but particularly the head and arms, accompanied with ringing of the ears; these are, shortly after, succeeded by others of a different nature; the eyes become inflamed and fixed; quick and laborious respiration takes place, accompanied by a very pleasant sensation, great muscular exertion, involuntary laughter, and a kind of incoherent dream; in the last stage of it, total insensibility succeeds, and unless great strength be employed it is with difficulty that the bladder can be removed from the grasp of the individual breathing it. Such were the effects which this gas had upon myself and several individuals on whom I experimented.

On the whole, the sensations are very similar to those produced by the intemperate use of spirituous liquors, with this difference, that after intoxication by ardent spirits, the subsequent debility is in proportion to the previous excitement; whereas, with the protoxide of azote, no debility is experienced, but rather an increased flow of animal spirits after the effects have entirely disappeared.

Dr. Ure seems to think it might be applied with success to persons

labouring under nervous complaints, &c. and those in which wine cannot, with safety, be administered;—in this case, however, the gas might be mixed with common air, in proportion to the strength of the patient.

Dr. Thomson asserts, that this gas never produced any other sensations on him but those of giddiness, and very often none whatever, and he seems to think it is more the effect of imagination than the singular property of the gas. I leave it, however, to those who may choose to experience it for themselves, whether it be the effect of imagination, or reality.

I am, Sir,
Your's, &c.
A STUDENT OF CHEMISTRY.

Glasgow, 28th April, 1824.

ON THE USE OF THE BAROMETER.

(Concluded from page 277.)

It has been ascertained, by repeated experiments, that the mercury falls one-tenth of an inch for every eighty feet of perpendicular height at which the barometer is placed above the level of the sea. This being the case, to render the words usually engraven on the scale, of any real use in pointing out the weather, scales should be constructed corresponding to the different heights above the level of the sea where the observations are to be made. Thus, a barometer placed at 160 feet of perpendicular height above the sea, should have the words on the scale placed *one-fifth of an inch lower*, than upon one placed on the sea-shore, or nearly upon a level with it.

When the rising and falling of the mercurial column, however, is principally attended to, there will be no occasion for altering the scale, whatever be the height of the place of observation, (I mean when the barometer is used as a weather-glass, for this does not hold good, when it is used as an instrument for measuring of heights,) as the difference is well enough pointed out by the mercury itself.

To those, however, who are more accustomed to look to the *words on the scale*, than to the *figures*, the following directions may be useful: If the mercury have been very low, as at *much rain*, and it ascend to *changeable*, then fair weather may be expected, although not of so long continuance as if it had risen higher. Should the mercury be very high, as at *set fair*, and it fall to *changeable*, then *foul weather* may be looked for, although it will not continue so long as if it had fallen lower. Upon the whole, then, I think it must be evident, that the barometer is a most useful article of furniture for the house of the farmer, and of every one whose business depends much upon the previous knowledge of the state of the weather.

W. S.

Our Correspondent might have added the *Shepherd of Banbury's Rules to judge of the changes of the weather:—*

1. If the sun rise red and fiery—*wind and rain.*
2. If cloudy, and it soon decrease—*certain fair weather.*
3. Horns of the moon obscure—*rain.*
4. When the moon is red—*wind.*
5. On the fourth day of the new moon, if bright, with sharp horns—*no winds nor rain till the month be finished.*

&c. &c. &c.

A LETTER ORIGINALLY ADDRESSED TO THE MARQUESS OF LANDSDOWNE,

ON THE

Weights and Measures' Bill now in the House of Lords,

And submitted to the consideration of the Committee.

[By Robert Wallace, A. M., Lecturer on Mathematics and Natural Philosophy, &c.]

To the Most Noble
The MARQUESS of LANSDOWNE.

My Lord Marquess,

I had the honour of addressing a letter to your Lordship, three days ago, respecting the Bill on the subject of Weights and Measures; but, for want of time, I was obliged to omit the following observations, which I intended to communicate to your Lordship.

Since the publication of the work which accompanied that letter, and more particularly of late, when so determined a resolution has manifested itself against the adoption of any new standard, or system, I have turned my attention more directly to the consideration of those plans which are most compatible with easy commutation, and which, at the same time, are the most consonant to practical and scientific simplicity, and to the existing popular notions on the subject. The following is a short sketch of the result of my investigations, which, with the various plans developed in the first and second sections of the Essay, I request the honour of submitting, through your Lordship's condescension, to the consideration of their Lordships the Members of the Committee on the Bill.

On the supposition that the Binary mode of division, recommended in pages 28, 29, *et seq.* of the Essay, was adopted, the present standards of linear, superficial, and cubic measure might be retained, and new measures of capacity, as well as weights, obtained, having a very simple reference to these standards, and coinciding very nearly with the weights and measures now in use. Thus, if in linear measure, every two of a smaller denomination were equal to one of a greater; in superficial measure, every four of a smaller denomination, equal to one of a greater; and in cubic measure, as well as in measures of capacity and weights founded on it, every eight of a smaller denomination, equal to one of a greater; then, the very simple relation of the roots, squares, and cubes of a series of numbers in Geometrical Progression, whose common ratio is two, would be preserved, and, by the exclusion of every other scale but the Binary and its Powers, the whole would be reduced to a system of extreme simplicity and precision. Supposing, now, that three inches of the present standard yard were assumed as the new unit of linear measure; its square as the unit of superficial measure; and its cube as the unit of cubic or solid measure, then the system might be simply arranged, as in the following Tables:

Linear Measure.

1 unit = 3 inches, or a quarter foot.

2 units = 6 inches, or a half foot.

4 units = 12 inches, or a foot.

Superficial Measure.

1 sq. unit = 9 sq. inches, or a sq. quarter foot.

4 sq. units = 36 sq. inches, or a sq. half foot.

16 sq. units = 144 sq. inches, or a sq. foot.

Cubic Measure.

1 cu. unit = 27 cu. inches, or a cu. quarter foot.

8 cu. units = 216 cu. inches, or a cu. half foot.

64 cu. units = 1728 cu. inches, or a cu. foot.

The scale of these Tables might be carried below unity in the same gradation, but the above may suffice to afford an idea of the plan. The measures of capacity might be the same with cubic measure, and indeed it is difficult to conceive, (upon the principles of common sense,) why they should be different; for brevity's sake, however, on this part of the subject, I would refer to page 57 of the Essay. The weights, of course, would be that of the cubic measures of distilled water at 62°, and the near coincidence of the new weights on this plan, with the present weights, will be strikingly evinced by the following Table:

Weights.

1 cubic unit of water = 1 new unit of weight = 0.974388 lbs. avoirdupois.

8 cubic units of water = 8 new units of weight = 7.79007 lbs. avoirdupois.

64 cubic units of water = 64 new units of weight = 62.320566 lbs. avoirdupois.

The second denomination for solids and liquids, that is, the cubic half foot, or 216 cubic inches, would according to this plan be *nearer* the present *Wine* gallon than that proposed in the Bill now before Parliament; nor (as facility of commutation is a property highly desireable) ought this advantage to be omitted, since the whole change necessary with regard to prices would be that every twenty shillings on the present pound weight would be *almost exactly* 6¼d. less on the new units of weight, whatever be their denomination. For $\frac{64-62\frac{1}{3}}{64} = \frac{1\frac{2}{3}}{64} = \frac{5}{192} = \frac{25}{960} =$ 6¼d.

I am aware that there is at present before their Lordships, the Committee on the Bill, a petition from the Chamber of Commerce of this City, containing a plan (proposed by my friend Mr. Wilson) which is similar to, or perhaps in some respects better than the preceding, and which, in a great measure, coincides with a plan developed in page 52 of the Essay, but which was originally proposed by Professor Playfair in a paper which he submitted to the consideration of the Highland Society. It must, however, be allowed, that though any of these plans are to be preferred to that proposed in the Bill, which is a mere accommodation to existing national prejudices, yet that plan which is calculated to last for ages ought to be unquestionably adopted, in preference to every other. And where could a simpler system be found than that which has been adopted by the French? A system, which, being founded on the very nature of number, interwoven with our very being, and coeval with the human race, would, were it adopted, render our practical and scientific calculations as easy as the four common rules of Arithmetic; and, being once established in such a commercial State as that of Great Britain, whose dominion and trade extend to all quarters of the globe, would undoubtedly be adopted by all other nations.

The arrival of the Bill at its present stage, surely exhibits a lamentable neglect of the honour of the country, in a scientific point of view, on the part of our mathematicians and philosophers, but

more particularly of those very distinguished philosophers, who have been honoured, by His Majesty's commission, to consider the subject of Weights and Measures. How would the immortal Newton, the glory of the British nation, express himself on such a subject, were he permitted to revisit the world, and to divulge his opinion, if he were informed that the British Parliament, having it in their power to confer a lasting benefit on the human race by the adoption and establishment of a perfect system of Weights and Measures, preferred a plan which is calculated to last only for a few years, to a system which was proposed, and partly carried into execution, by the only philosopher who for a century after he lived could be compared with him, and of whom Professor Playfair says, with justice, "that the genius of the human race is the only rival of his fame?" It is easy to conceive, that, superior to all national prejudices, he would at once give his most unqualified approbation to the Denary system. May the followers of his footsteps, in the sublime paths of philosophy, see that they offend not the shade of their master by the recommendation and adoption of an imperfect system of Metrology.

Finally, the attention of their Lordships the Committee on the Bill, ought to be called to this important fact, that the plan of the present Bill, at least in the scientific part, which is of the greatest consequence, differs in *no other respect* than a few arithmetical corrections, from the Bill which passed the House of Commons in 1816, but which was thrown out of the House of Lords, on account of its being "a crude and imperfect scheme, prepared without due consideration of the various bearings of so nice a question, and consulting partial or present conveniency at the expense of permanent and general utility."

I have the honour to be, my Lord Marquess, your Lordship's most obedient and most humble servant,

ROBERT WALLACE, Jun.

Glasgow, 31st May, 1823.

We have inserted the above letter, on a very important subject, and one that interests the country at large, as we understand that the Bill which afforded subject for these remarks has been again introduced into Parliament this Session, although it was rejected in the House of Lords after having passed the Commons last year. It is the more necessary that the attention of the public should be called to the progress of this Bill, as it has already passed the House of Commons a second time, a circumstance that shows the very great inattention of commercial men in this country to a subject, which, one would have thought, should have been considered, by *them, at least*, of the first importance. We sincerely hope that this Bill will be again rejected in the House of Lords, as it is evident, from the inadequacy of the plan, to introduce uniformity and simplicity into our commercial calculations, that it merits *no other fate.*

We understand, that, by the exertions of a single individual, John Wilson, Esq. of Thornly, in drawing the attention of the Chamber of Commerce of Glasgow to the subject, and in convincing them of the necessity of petitioning Parliament last year, (which, to their very great credit, they did at his suggestion,) the Bill was prevented from passing in the House of Lords without proper investigation; and that House will ever merit the gratitude of the country for the readiness with which they

referred the subject to a Committee, though no complaint or petition was forwarded from any quarter of the kingdom, but this city. The share which the communications of our Correspondent might have, in drawing the attention of that Committee, would be but small, compared with the effect which the petition of such a respectable body as the Chamber of Commerce of this city was calculated to produce. Still, however, we conceive that it is the duty of individuals, who are acquainted with these subjects, to endeavour to prevent the adoption of an inadequate remedy for the evils which are acknowledged, on all hands, to pervade our system of Weights and Measures, and which in no case are more glaring than in our own city. And we have reason to believe, from the circumstances which we understand have taken place in the case of our Correspondent, that no idea of the superiority of rank, which commonly enters weak minds, will ever prevent the highest Legislature of our country from attending to the suggestions of such individuals, when submitted to them in that proper spirit of respect and attention which is due to their high station.

ON THE DISCOVERIES OF SIR ISAAC NEWTON.

(Continued from page 285.)

HAVING, in our last, given a succinct account of the life of this extraordinary genius, we proceed to recount some of his most remarkable discoveries. The illustrious discoverers who had already shone in the various departments of mathematical and physical science during the seventeenth century, were destined to be eclipsed by one of a higher order. Kepler and Galileo had established the true system of the world revived by Copernicus; Descartes and Huygens had distinguished themselves by their philosophical researches; Napier, Wallis, Gregory, Barrow, and Roberval, had made rapid advances in the pure sciences; Torricelli, Otto Guericke and Gilbert, had, by their discoveries, extended our knowledge of nature; and science was about to take a higher flight, when Newton arose and bore away the palm of triumph.

The age in which he lived, was destined to behold a series of the most splendid discoveries ever recorded in the history of philosophy. *The invention of* Fluxions, the discovery of the composition of Light, and that of the principle of Universal Gravitation, were all the achievements of his individual genius, and any one of them was sufficient of itself to have immortalized his name.

Newton began his discoveries in Geometry, where the most skilful men of his time had failed. The introduction of infinite quantities into that science had extended its domains, and had enabled geometricians to obtain valuable results, from which, as if by magic, the idea of infinity had wholly disappeared. Wallis, in his Arithmetic of Infinites, had effected the quadratures of all curves, where the value of one of the co-ordinates could be expressed in terms of the other, by means of integral and positive indices; but, in attempting to obtain the quadrature of the circle, he had partially failed, owing to his inability to express the values of those co-ordinates which involved fractional or negative exponents. Newton taking up the subject where Wallis left it, and pursuing the same

ideas, but with more expanded views, discovered the law which was common to all the areas of the curves which had been computed, and thus arrived at the quadrature of the circle and various other curves, in which the relations of the co-ordinates were expressed in fractional exponents, and their areas in the form of infinite series. By this means he discovered that invaluable formula, the Binomial Theorem, which, in fact, contained in itself all the various expressions which he had separately obtained with so much labour, but which now seemed all to spring from this one root, as from a universal and common parent stock.

Newton was soon led from these discoveries, which occurred in 1663, to the principle of the New Geometry, which he applied to the investigation of problems so early as the year 1665, and the invention of which was afterwards so unjustly contended for by Leibnitz. Dr. Barrow had received from the hands of Newton himself, a manuscript treatise, in which the principles of Fluxions were distinctly pointed out, and he strongly exhorted his young friend to publish this treasure to the world. The modesty of the author, however, which, if not culpable, was, in this instance, very unfortunate, rendered his exhortations unavailing; and the treatise was not published till the year 1711, a period of at least forty-three years after it was written. That this delay was unfortunate, was evinced by the dispute which soon after arose between the countrymen of Newton and those of Leibnitz, respecting the priority of the invention. Some of Newton's discoveries had been communicated to Leibnitz at various times, but particularly in 1676, by Oldenburg, the Secretary of the Royal Society; and in the following year, Leibnitz, for the first time, transmitted a letter containing an account of his Differential Calculus. From this, it is evident, that Newton was the first inventor of the new analysis, which he denominated Fluxions, and that Leibnitz was only the second inventor of the same analysis, though he gave it a different form and name.

While Newton's discovery, however, remained a secret only known to a few, that of Leibnitz, by its publication in 1684, spread rapidly over the continent. Two illustrious mathematicians, the brothers James and John Bernoulli, had made themselves masters of the differential method, and were extending its powers by the solution of problems hitherto unapproachable, either by Algebra or Geometry.

Owing to the reserve of Newton, his countrymen in general were still ignorant of his discoveries, and they were first made acquainted with the new calculus, by a work in which the author stated that he derived his knowledge of the subject from the writings of Leibnitz and the other continental mathematicians. No rivalry or hostility had yet arisen between the inventors. The Members of the Royal Society justly believed that the new analysis was the original invention of Newton; while the Germans and the French believed it to be that of Leibnitz. So long as each was ignorant of the claims which the other had to prefer, no animosity could arise, but if once the tranquillity that existed under such circumstances was disturbed, it was not likely to be speedily restored. A remark, accordingly, which was made by De Duillier, in a paper, on the line of swiftest descent, was sufficient to light up a flame which a whole century was hardly sufficient to extinguish. This individual asserted Newton's claims, and insinuated that Leibnitz had borrowed his invention. This charge was repelled

by Leibnitz himself in the Leipsic Journal, and retorted by other writers in the same Journal upon Newton. A war was now declared in the republic of science between the English and Germans, which was carried on with much asperity on both sides, though the inventors themselves, and particularly Newton, took little or no share in the dispute. The English mathematicians being at that time (and even yet) less skillful in the new analysis than their opponents, were frequently worsted, and it was only when Newton himself condescended to answer their problems, that a victory was gained.

A problem respecting the Brachystochrone, or line of swiftest descent, which was proposed in 1697, as a trial of skill between the contending parties, was found so difficult as to be resolved only by the most distinguished Analysts, Newton, Leibnitz, John and James Bernoullis, and M. de l'Hopital. Newton's solution appeared in the Philosophical Transactions without a name, but the author was easily recognised. John Bernoulli, on seeing it, is reported to have exclaimed, *Ex ungue leonem!* The problem of orthogonal trajectories, which was to describe a curve that shall cut a series of similar curves, described according to a given law, at right angles, was, in 1716, proposed by Leibnitz, as a defiance of the skill of the English mathematicians. This problem was delivered to Newton on his return from the Mint, at a time when he had been much fatigued with the business of the day; yet before he retired to rest, he resolved it the same evening, and his solution, though without his name, appeared in the Philosophical Transactions for the year 1716.

Under such circumstances, was the greatest discovery ever made in the mathematical sciences, ushered into the world. Wherever it was made known, it enlarged the views, roused the activity, and increased the power of the geometer, and filled his mind with sentiments of gratitude and admiration towards the great inventor. In one respect, only, were its effects different from those which should have been produced; it excited jealousy between two great men who ought to have been friends, and disturbed in both that philosophic tranquillity of mind for the loss of which even glory itself is scarcely a recompense.

Though gradual approaches had been made towards the new analysis during the progress of ages, yet there were some individuals who made such great and sudden advances, that they are justly elevated far above their predecessors and cotemporaries. Euclid, by his method of Exhaustions, which was afterwards employed with so much success by Archimedes, Cavallieri by his method of Indivisibles, Descartes by his application of Analysis to Geometry, Newton by his invention of Fluxions, and Leibnitz by his method of Differentials, constitute the great leading links in the direct line of advancement to this grand discovery.

The new analysis was soon found to be peculiarly adapted to the investigation of the laws of nature; and the view of it given by Newton, was more adapted to this purpose than any other, as the supposition of the generation of quantities, by continued motion, coincided exactly with what takes place in the material world. The momentary increments, or fluxions, represented so precisely the forces by which the changes in nature were produced, that this analysis seemed created for the express purpose of penetrating into the interior of things, and of taking direct cognizance of those animating powers which, by their subtility, not only eluded the observations of our senses,

but the common methods of geometrical investigation. This analysis alone furnished the means of measuring forces, when each acted separately and instantaneously under conditions that could be accurately ascertained.

In comparing the effects of continued action, the variety of time and circumstance, and the continuance of effects after the cessation of their causes, introduced so much uncertainty, that vague and unsatisfactory conclusions could only be deduced. The new analysis, however, went directly to the solution of these difficulties; it measured the intensity, or instantaneous effect of the force, and removed all those causes of uncertainty which existed when the results of continued action could alone be estimated. It was not, therefore, even by the effects produced in a short time, but when they were taken in their nascent or evanescent state, that the true proportion of causes could be ascertained. Thus, for example, though astronomers had discovered that the planets describe ellipses round the sun as the common focus, and that the radius vector, or line drawn from the sun to each planet, sweeps over areas proportional to the time; yet had not geometers resolved the elliptic motion into its primary elements, and compared them in their evanescent state, it would never have been discovered that these bodies gravitate to the sun with forces which are universally as the square of their distances. In this way, fortunately, it happened, that the first discovery of Newton, was the only instrument which was destined to conduct him safely through all the intricacies of his future investigations.

(To be continued.)

VARIOUS COMMUNICATIONS.

ON ELECTRIC ATTRACTION.

In reply to T. V.

Paper is an electric, and the Indian rubber acts in the same manner as the rubber in an electrifying machine, namely, in exciting electricity. Now, when the paper is electrified, it not only attracts light substances, as it did with the cuttings of the quill, but is, itself, attracted by any other substance that is in a different state of electricity. On this account it was attracted to the table; and it was attracted more strongly by being heated at the fire, owing to its being made a better electric by thus driving off any dampness.

I trust these observations will inform your Correspondent what kind of attraction affected the paper; *but of the cause* of this attraction, I must confess that I am ignorant.

C.

Paisley, 24th April, 1824.

Sir,—T. V., in your 17th Number, requests to know what kind of attraction it is that he had accidentally discovered in rubbing out black lead lines on dry writing paper.

It is very singular, that, about 35 years ago, I observed the same kind of attraction myself, and showed it to the late Professor Anderson, when, by the assistance of an electrometer, we discovered it to be positive electricity. Upon throwing this excited sheet of writing paper against the dry painted wainscotting of the room, it adhered to it for more than an hour with con-

rce. The Professor ever ited this experiment an- his class as long as he he late Dr. Garnet, to d communicated this fact, ne for a number of years on's Institution, so that ical phenomenon is not

As the excitation is so very dry writing paper kly rubbed with the elas- might not an electrical be constructed out of a strong pasteboard, well ith smooth writing paper, eets in thickness, and ic gum rubbers fitted up nciples of the glass plate

I am, Sir,
Your obedt. servant,
J. P.

8th April, 1824.

OF BENDING IRON HOUT CRACKING.

DITOR,—In reply to the W. T. in your Twelfth March 20, I beg to sug- following hint. He may pe, or the part he wishes with melted lead, and ely on the lead ceasing id, and while it is yet will find the pipe bend ly into any form he may hollow groove across a ece of iron, suppose the k of a smith's anvil, of a ble for the pipe, may be bend the pipe over. By up the warmth, he may bend into any form he s iron will very readily that heat. After having the wished-for curve, it sy to melt the lead out of

I am,
Mr. Editor,
Your's,
One of the Cyclops.

MODE OF MAKING SCREW TOOLS.

Mr. Editor,—I observed in No. XII. of your Magazine, a machine for making screw tools or combs. I beg leave to state, that screw tools may be likewise made on the following plan, which is more simple and will answer the end equally well. A nut must be made of the size of the tap; if a $\frac{5}{8}$ tap, a $\frac{5}{8}$ nut, &c. Then cut a space out of one side of the nut, with a bevel, to correspond with the comb to be cut; then place the comb to be cut in the space cut out of the nut; make it fast in the vice, and screw it with the tap till the thread be full. By this method, combs may be cut more speedily and as well as those done with a cutter.

W. W.

Duntochar, 29th March, 1824.

RECIPE FOR GINGER POWDERS.

White sugar, a quarter of an ounce; four grains of ginger; subcarbonate of soda, twenty-eight grains; tartaric acid, thirty grains; these proportions are intended for eight ounces of water, or half a pint English. This beverage is a much better stomachic than the ginger beer made by fermentation.

D. B.

EASY MODE OF FINE-EDGING RAZORS.

Glasgow, 4th May, 1824.

Sir,—If every individual were to communicate to the public the improvements on common subjects that accident or experience has suggested to him, the sum of our useful knowledge might be considerably increased. I therefore think the insertion of the following *domestic* fact may be useful to some.

Many experiments have been made on the best mode of giving a *fine edge to razors;* and the num-

berless patents on the subject of *strops*, indicate that the want of a good plan for rendering *shaving* agreeable—or rather less disagreeable—is one of the petty " miseries of human life." All these patent methods are perfectly trifling in effect, compared to the following simple *way of giving a razor an exquisite edge*. It is without the smallest expense, and in the power of every one desirous of a smooth chin:—

On the rough side of a strap of leather, or on the undressed calf-skin binding of a book, rub a piece of tin, or a common pewter spoon, for half a minute, or till the leather become glossy with the metal. If the razor be passed over this leather about half a dozen times, it will acquire a finer edge than by any other method.

As this fact may not be generally known, its insertion may be of use.

Y.

MISCELLANIES.

Typhus Fever.—Dr. J. C. Smith obtained £5000 from Parliament, for the following recipe: R. 6 dr. powdered nitre, 6 dr. of oil of vitriol, mix them in a tea-cup by adding to the nitre one drachm of the oil at a time. The cup to be placed during the preparation on a hot hearth or plate of heated iron, and the mixture stirred with a tobacco pipe. The cup to be placed in different parts of the sick-room.

To determine whether Wheat Flour, or Bread, be adulterated with Chalk.—1. Mix with the flour to be tried, a little sulphuric acid: if chalk or whiting be present, an effervescence (arising from the discharge of the carbonic acid of the chalk) will take place; but if the flour be pure, no effervescence is produced.—2. Pour boiling water on some slices of bread, and then pour into the water a little sulphuric acid; if there be any chalk in the bread, an effervescence will ensue, as before; but if none be in it no effervescence ensues.—*Griffin's Chem. Rec.*

To detect Copper in Pickles or Green Tea.—Put a few leaves of the tea, or some of the pickle cut small, into a phial, with two or three drachms of liquid ammonia, diluted with one half the quantity of water. Shake the phial: when, if the most minute portion of copper be present, the liquid will assume a fine blue colour.—*Ib.*

Test for Jelly.—Let a grain of isinglass, glue, or any other gelatinous matter, be dissolved in a gobletful of water, and let a few drops of tincture of galls be added to the solution: the immediate product will be an abundant flocculent precipitate. This precipitate is a compound of the *tan* of the gall, and the pure *gelatin* of the jelly.—*Ib.*

To determine whether water be hard or soft; that is, whether or not it be fit for domestic purposes.—To a glassful of the water add a few drops of solution of soap in alcohol. If the water be pure, it will continue limpid; if it be impure, white flakes will be formed.—*Ib.*

NOTICES TO CORRESPONDENTS.

We wish that T. G. would recompose and condense his observations on the sounding line, as we really cannot make out the meaning of some of them.—We are obliged to 'Rusticus' for his last communication, which shall appear in due time; we beg leave to inform him that the proposer of the query respecting the *point of meeting*, having solved his case of the 19 miles, requests to know his address, so as to obtain his promised reward, by showing him the solution previous to its insertion in the Magazine.—Z. is partly superseded.—'Opifex,' D. L. M., J. D. C., and M. A., will be inserted.—W., of Lanark, and G. B., of Hamilton, under consideration.—We are in arrears with some of our Correspondents, and must really crave their indulgence for a little.—We cannot see upon what principle A. would propose that the first proprietor of the stair should pay one-fifth of two-ninths; this is a strange mixture of parts; that, at one time, the stair should be considered as divided into 4½ shares, and, at another time, into 5 shares; the solution given by 'Hutchesonus Frater' proceeds on the simple supposition, stated in the query, that the expense is to be paid in the proportion of 4½ shares, and not in that of 5 shares; hence, it must appear absurd to alter the nature of the question, and then to assert that the solution is wrong.

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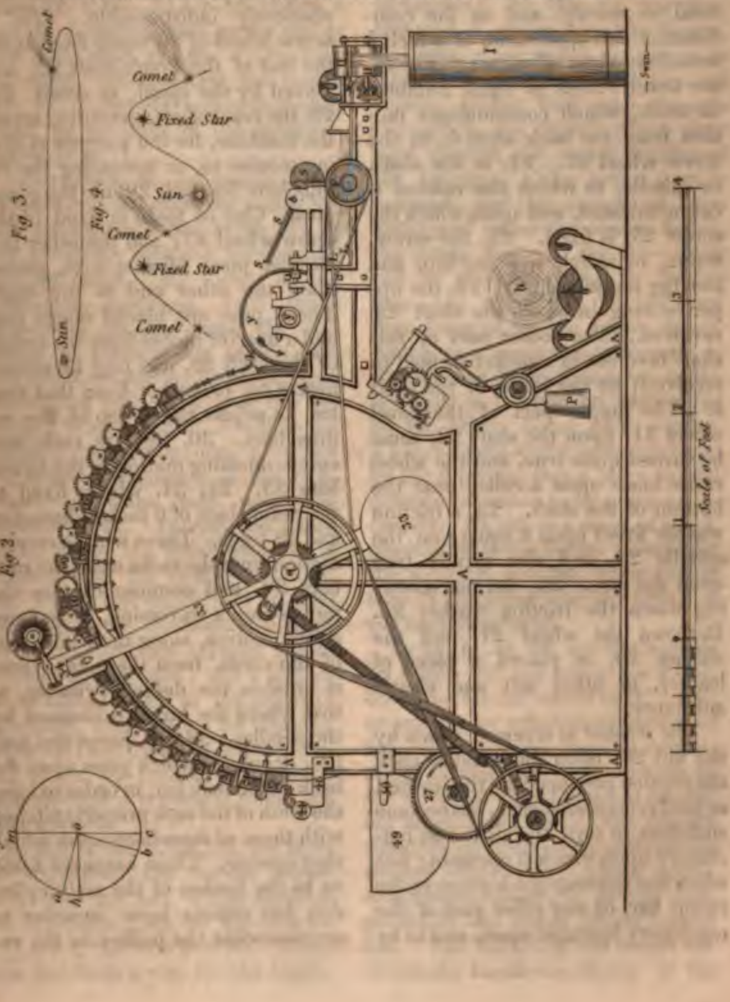
J. CURLL, PRINTER.

THE GLASGOW
MECHANICS' MAGAZINE.

———————— " From Saturn's ring,
In which, of Earths an army might be lost,
With the bold Comet, take my bolder flight,
Amid those sovereign glories of the skies,
Of independent, native lustre, proud;
The souls of systems! and the Lords of life,
Through their wide empires!"—*Young.*

No. XX. *Saturday*, 15*th May*, 1824. Price 3*d*.

Mr. BUCHANAN'S PATENT CARDING MACHINERY.



Mr. BUCHANAN'S PATENT CARDING MACHINERY.

(Continued from page 292.)

As I have distinguished all the parts of the engine, which I have already described by alphabetical letters, except the top cards T, progressively numbered from 1 to 20 inclusive, I have, to prevent confusion or misconception, adopted numerals, commencing at 21, to designate those parts delineated on the said drawings, which I now proceed to specify, and on the combination and application of which I found my right of patent. 21, 21, are bevel wheels of equal numbers of teeth, which communicate motion from the back shaft *b*, to the screw wheel 27. 22, is the shaft, or spindle, to which this motion is communicated, and upon which the screw 23, is fixed. 23, the screw, worm, or spiral, working into and moving the wheel 27. 24, the upper bearing in which the shaft 22, revolves. The lower part of this shaft revolves in a socket formed to receive it on the brush of the shaft *b*. The upper part of the bevel wheel 21, upon the shaft 22, must be turned quite true, and the wheel turns loose upon a collar near the bottom of the shaft. 25, a friction washer fitted upon a square on the spindle 22, and also turned true upon the face. 26, the nut screwing down the friction washer 25. Between the wheel 21, and the washer 25, is placed a piece of leather, or other soft and elastic substance.

The washer is screwed down by the nut 26, upon the spindle, until the friction produced by the leather, or intervening substance, has become sufficient to turn the shaft and machinery upon which it operates; but when any interruption is given to the radius bar, or any other part of the machinery operated upon, and to be afterwards described, the true turned and smooth surface of the wheel and washer, by sliding along the leather, or interposed substance, will permit such part of the machinery, as is exposed to danger by the obstruction, to remain at rest and without injury. This arrangement may therefore be considered merely as precautionary, and is not absolutely indispensable. 27, a screw wheel of 96 teeth, fixed upon the end of the crank shaft 28, and moved by the spiral, or screw, 23. 28, the crank shaft, extending across the machine, for the purpose of giving motion to, or traversing the radius bars 33. 29, 29, are the crank pins. One of these is fixed in the screw wheel 27; and the other in a circular piece of cast iron, placed upon the other end of the shaft. These pins are placed about four and a quarter inches from the centre of the shaft 28, and may be shifted nearer to, or farther from that centre, to adjust the sweep of the radius bars. 30, 30, are rack bars communicating motion to the radius bars 33. 31, 31, wheels fixed to the radius bars of 6 inches diameter, and 48 teeth. These wheels receive motion from the racks upon the rack bars 30, and communicate to the radius bars a traversing, or reciprocating motion, along the whole arch of top cards, from the point where it brushes the doffing cylinder, to that where the brush is cleaned by the needles. 32, 32, hasps and pullies, or rollers, which press upon the back of the rack bar, in order to keep the teeth of the rack properly pitched with those of the wheels upon which they operate. These hasps are fitted on to the bushes of the main cylinder, but remain loose, in order to accommodate the pullies to the va-

rying angles of the rack bars, in revolving round the centres of the crank shaft. 33, 33, are the radius bars, with balance weights below, to counterpoise them when at the extreme points of the range of motion. 34, 34, tops attached to the radius bars, and moveable at pleasure. 36, 36, arms fixed upon the moveable top, for conveying the revolving brush which cleans the top cards. 37, the revolving brush.—(See fig. 1, No. XIX.) 38, pulley, 6 inches diameter, fixed on the end of the brush shaft, or axis. 39, the belt, or strap, which drives the brush. 40, 40, pullies of 6 inches diameter, fixed on the ends of the main cylinder axis.

The pullies 40, by means of the crossed belt 39, drive the pulley 38, and consequently the brush 37, in the direction required for cleaning the top cards. By means of the apparatus described, each semi-revolution of the crank 29, will move, or traverse the radius bars 33, and the revolving brush 37, from the doffing cylinder *y*, over the top cards, brushing and cleaning all which are turned up, until it reaches the opposite extremity of the arch, where it cleans itself upon the needles at 41. During the pause made, whilst the brush wheel is in contact with the doffing cylinder, and whilst the crank pins passing the centre give the least motion to the radius bar, that cylinder is also brushed and cleaned; and a similar pause taking place at the opposite extremity, affords time for cleaning the brush itself from the cotton, dust, and motts, by making its bristles pass through a moveable frame set with needles.

In fig. 1. and 2. 48, 48, are arms for supporting the needle frame. 49 is the iron box which receives the strippings. 50, 50, are pins for supporting the iron box 49. These pins also form a rest for the implements, or utensils, used for stripping, grinding, and brushing the main cylinder, when cleaning out the cotton, grinding the cards, and polishing with the brush. By removing the box 49, part of the sheet iron back lining may be folded down, which allows room for admission to the sheet cards of the main cylinder. The mode of turning up, and of returning the top cards to their working position, is as follows: 35, 35, &c. are pins, the tops of which form the hinges, or joints, upon which the top cards turn. The bodies of these pins are square, where they pass through the upper, and round where they pass through the under flanches of the framing. The round part is screwed, and by means of nuts above and below the under flanch, the front part of the top cards can be set nearer to, or farther from the cylinder. 52, 52, are pins screwed in the upper flanch, which, in a similar way, elevate, or depress the back of the top cards, one only is marked on each side; all the others being quite similar. These pins are so distinctly exhibited by the drawing, that a more special description seems to be quite unnecessary. 53, 53, is a piece of wood, placed across the frame, to support the top-card, No. 20, when turned over to be cleaned by the action of the revolving brush.

In fig. 1. 54, 54, are the handles by which the top cards are lifted. 55 is the ratchet wheel of 51 teeth, or spaces, by which any number of top cards required, may be successively turned over, and exposed to the action of the cylindrical revolving brush. 56, 56, 56, 56, 56, are triangles screwed to the arms of the ratchet wheel 55. These points alternately elevate a sliding rod, placed in the inside of the radius bar. The motion of the radius bar raises the handle to the top of the

groove, where the top card, acted upon, turns the centre. 62, (figure 1.) is a stud, fixed to the balance weight of the radius bar 33, which is brought up to the jointed lever 63, when the revolving brush is in contact with the doffing cylinder. 63 is the jointed lever, which being elevated by the stud 62, turns the ratchet wheel 55, one tooth, or space, and causes the top cards to be turned over in regular rotation. 64 is a spring attached to the framing, which falls into the notches represented upon the circumference of the wheel 55, and keeps it steady and stationary during the revolution of the radius bar. Thus, after the top cards 9 and 20, have been turned over and cleaned, as described, the ratchet wheel being moved one tooth, or space, the triangles are brought to act upon the top cards 8 and 19, and thus successively upon all the other top cards. Two top cards are consequently cleaned during each revolution of the crank shaft, with the exception of two top cards for each revolution of the ratchet wheel 55; and by placing more or fewer triangles upon its circumference, a greater or smaller number of top cards may be cleaned during each revolution. In drawing 2. 65 is a toothed arm, or rack bar, attached to the radius bar 33, and 66, 66, &c. are 18 semi-wheels, fixed upon the axis of the top cards. By means of these semi-wheels, which come in contact with the rack bar 65, when the top card is turned over; each top card (19 and 20 excepted) is returned to its working position, so soon as it has been cleaned by the revolving brush.

The tops 19 and 20, which have no semi-wheels, and are placed beyond the reach of the rack bar 65, are returned into their working positions immediately after being cleaned by the return of the radius bar and the ascent of the handle through the groove 59, and its descent through 60, as already described, &c. &c.

Glasgow, 28th March, 1824.

ON THE CONSTRUCTION OF THE THERMOMETER.

(Continued from page 263.)

Some precautions must also be taken in making the mercury enter the bulb of the thermometer. As the tube through which it is introduced is commonly very small, the difficulty formerly mentioned is here experienced, and which is occasioned by the resistance of the interior air. It is, however, avoided in the following manner: The bulb of the thermometer is heated; the air which it contains expands and escapes; at this favourable instant the open end of the tube is plunged into the mercury which is to be introduced into it, and consequently while the bulb cools, the pressure of the exterior air causes it to ascend.

It is necessary also to heat the tube, to a very considerable degree, before introducing it into the mercury, that the water, which has been allowed to enter while blowing the bulb, if it has been done with the mouth, may be evaporated; and also, that the coating of air and humidity which always adheres to the glass in the ordinary state of the atmosphere, may be dispelled. Besides, in this operation, it is necessary to begin by heating the tube only and not the bulb; then, when it is very warm, this is rectified, by heating the bulb speedily in its turn, and the air which is inclosed dilating with rapidity, drives before it all the small im-

purities which the tube may have contained, and which may have hindered the motion of the mercury along its sides.

In these operations, it sometimes happens that we cannot, at first, put in as much mercury as will fill the bulb and part of the tube. The operation must then be repeated by heating anew the bulb and the mercury contained in it. When it is strongly heated, we plunge again the open end of the tube into a vessel full of mercury, and repeating this operation a few times, we may introduce as much mercury into the bulb, and into the tube, as may be reckoned necessary.

The quantity of mercury which ought to be put into the thermometer, depends on the use for which it is intended. If it is to be employed for all temperatures, from that of boiling water to that of the greatest cold which is felt in our climates, the capacity of the bulb and the length of the tube must have certain proportions which are the result of experience. If we have put in too much mercury, or if the tube is not of a sufficient length, it will happen that at the temperature of boiling water the mercury will fill the whole of the thermometer, and run out of the orifice, if it is open; or if shut, it will strike the top of the tube and break it. If, on the contrary, we have not put in enough of mercury, it will happen, at the greatest cold, that the mercury will enter and be wholly contained within the bulb, so that its contractions will no longer be observable. When we try for the first time to make a thermometer, it is only by experience, in putting the apparatus alternately in boiling water and in ice, that we learn to know pretty nearly the quantity of mercury which should be put into it; but when we know *the law of the dilatation* of *mercury, calculation* gives the direct and sure means to avoid these inconveniences.

When the mercury is introduced into the bulb and the tube, it is next necessary to expel all the small bubbles of air which have been mixed with it; for their dilatations, different from that of mercury, and their compressibility, would affect the regularity of its motions which are to be observed. The only means of completely excluding them, is to heat the bulb till the mercury boils before the tube be sealed. This operation, however, drives up through the tube a part of the mercury which was put in, and which was necessary to fill the bulb at less degrees of heat. To avoid this inconvenience, it will be necessary to construct the open extremity of the tube with a swell in the form of a small balloon, so that the mercury in dilating and coming out of the tube by its expansion, may not run over, but only spread through this reservoir. When the boiling ceases, and the mercury contracts, the pressure of the exterior air will be alone sufficient to cause all the mercury to return into the tube.

This operation being done, if enough of mercury has been put in for the extremes of heat and cold to which the thermometer is to be exposed, the tube must be hermetically sealed, for it would be no more comparable with itself if any portion of the mercury should escape. We must even, in sealing it, endeavour to exclude all the air which might remain in the tube above the column, not that this air could oppose the dilatation of the mercury which takes place with an irresistible force, but lest that, in agitating the thermometer, some small air-bubbles should be introduced into the column and break its continuity; for then it would be very difficult to get rid of them, especially if the tube were very narrow. To expel this air entirely, we first take away

from the open end that part of the tube which had been formed into a reservoir; and then heat the bulb of the thermometer till the mercury, expanding by heat, reaches to this extremity of the tube; at this instant we seal the end of the tube, and thus the air is entirely excluded, so that it cannot return when the mercury begins to cool.

It is easy to ascertain whether a thermometer has been constructed with this precaution. We have only to invert it, and if it is free of air, and if the bore of the tube is not extremely fine, the mercury will fall freely from the bulb and fill the tube; but if the air has not been expelled, the column of mercury will not just fall to the bottom of the tube, because the air which remains by its elastic force resists the pressure of the column and hinders it from reaching the bottom.

When thermometers are carried on a voyage, it often happens that the column of mercury separates into several parts, and on account of the small quantity of air that remains in the tube, these different parts are not easily joined again. To effect this, we must attach a cord of a convenient length to the tube, and whirl it about like a sling as rapidly as possible. The centrifugal force acting more strongly on the mercury than on the air, on account of its greater mass, is commonly sufficient to re-unite the separate parts of the column. It will be better, however, in practice, to have a small swelling, or reservoir, at the top of the tube, and when any separation takes place in the column, to heat the bulb so strongly as to cause the mercury to rise into this reservoir; after which, allowing it to cool slowly, it will re-enter the tube in a continued mass. Thus the thermometer is most accurately constructed.

ON THE HIGH PRESSURE STEAM ENGINE.

THE last Number of the London Journal of Arts and Sciences, contains some new accounts of Mr. Perkins' operations. It is well known that Mr. P. has, for a long time, been making experiments, in order to prove the practicability and economy of using very highly elastic steam, to work steam engines, and that his results had as yet been very unsatisfactory. He ascribed his bad success to the difficulty of procuring a vessel for generating the steam, sufficiently strong to contain it, under the immense pressure to which it was subjected. We were lately told, that he had succeeded in removing this difficulty; having procured a steam generator, or boiler, formed entirely of malleable iron, without a seam or rivet; and we are now informed, that he has succeeded in demonstrating the power of his engine to a select party of friends, by lifting a given column of water through a certain space. He has not as yet given the detail of his experiments to the public, but he is circulating a small pamphlet among his friends, containing the results he has already obtained. An abstract of this pamphlet is given in the Journal to which I have alluded.

Mr. P. refers in his pamphlet to volcanic eruptions, (which he believes are produced by the sudden explosion of vapour, which has been confined and heated, until its elasticity has become adequate to the effects,) as a proof of the immense power of confined steam. The almost infinite force of highly heated steam was never doubted; but it is a mistake to suppose that this force

can be obtained without a proportional absorption of heat. It is very true, that a thermometer plunged in steam of the same elasticity as the atmosphere, stands at 212°; and if it be put into steam of double that force, that it will stand only 38 degrees higher; but it has been proved beyond a doubt, that, taking bulk for bulk, the strong steam contains twice as much heat as the other, or, in other words, the same quantity of heat is absorbed in producing one cubic foot of steam of two atmospheres, as in producing two cubic feet of steam of one atmosphere, and in producing steam of three atmospheres, as much heat is absorbed as would be necessary to generate three times the same quantity of steam of one atmosphere. The very same law holds for every other elasticity. The application of this law, with a very little consideration, will convince us, that no form of engine can ever supersede the condensing one in point of economy, although Mr. P. supposes that the condensing apparatus occasions a waste of not less than 1070 degrees of heat, out of 1170. That this loss is sustained is not denied; but there is no instance where power is produced, without some suitable expenditure; in the water wheel there must be a fall of water proportional to the work it performs; the wind mill deprives the air of its momentum; and in the steam engine we must be contented to expend heat.

Mr. P. does not pretend to produce power without this heat; but he asserts that he can return the most of it to the generator, after having done its work in the cylinder. In his pamphlet, he states, that "nearly all the heat has been absorbed from the steam, and returned to the generator." Before the equilibrium between the two sides of the piston can be destroyed, the temperature of the steam on one of the sides must be reduced, and more power will be obtained, the greater this reduction of temperature is. But to reduce the temperature in any considerable degree, the cold water thrown in, must bear a very considerable proportion to the water existing in the form of steam; a very inconsiderable portion of this water is therefore needed to supply the waste of the boiler, which is exactly equal to the quantity thrown out in the form of steam. The greater part of the heated water must necessarily be thrown away as useless, and with it, it carries off the greater part of the heat which the steam had brought out of the generator. If it is attempted to remedy this, by throwing in a very little water, the temperature of the steam will hardly be diminished, and the power of the engine will, of course, be inconsiderable. In short, the power gained in a judicious engine, will be in direct proportion to the heat taken from the steam after it is ready to enter the condenser. How Mr. P. therefore contrives to return so much of the heat to the generator, is altogether a mystery; he does not appear to be at all warranted in making such an assertion, unless he is able to overturn completely our present knowledge of the properties of steam; and if any credit is due to the experimenters on this subject, our knowledge is supported by the most undoubted facts.

Throwing economy altogether out of consideration, the danger attending Mr. P.'s engine must prove a great bar to its adoption. He acknowledges that the boiler must be able to stand a pressure of 60,000 lbs. on the square inch; but every person who is aware of the rapid decay which a boiler of a thickness adequate to this strength must undergo, in being continually exposed to a red heat, will be convinced of the danger of introducing it into

general use. Could this danger be got over, it would certainly be a great acquisition as a locomotive engine, from the small quantity of materials it would require, even although it should be attended with no saving of fuel.

A. W. J.

Port-Glasgow, 11th May, 1824.

HERESIES RESPECTING COMETS AND LIGHT.

By JAMES RENNIE, *A. M.*

Lecturer on Philosophy at the Russel and at the Surrey Institutions, London, Editor of 'The Quarterly Journal of the Medical Sciences,' &c. &c.

Mr. EDITOR,—Though I cannot help thinking that very learned discussion—by which I mean all absurd and unintelligible stuff falsely called science and philosophy—is much out of place in your popular and interesting work;—yet, as this kind of nonsense is very abundant both in books and at the Universities, from which it spreads among the reading population to the great destruction of useful knowledge, I think you could not do better than expose, as you may find occasion, what is only tolerated, because it is mysterious, grave, solemn, and out of the reach of a plain man's understanding. I am one of those heretics in philosophy who maintain that there is nothing useful in science which may not be easily explained to men of common intellect, if the explainer could be persuaded to lay aside his long-sounding words, that smack of nothing but Catholic monkery; and his mystical modes of thinking, which are not, surely, learning, but ignorance, in a philosopher's mask. Your work, I think, is the very instrument to unmask this mummery of learned phrase and solemn jargon, and to diffuse useful learning and knowledge among our reading and intelligent peasantry and operatives.

I have been led into these reflections by a little work, just sent me by the Editor of the Eclectic Review, entitled, "Philosophical Remarks on the Theory of Comets, &c. By Wm. Cole." The author, (and, as I think, very justly,) demurs to the dogma of astronomers, that comets perform a circuit round the sun, and return in the same way as Jupiter and the other planets. He says, and says truly, that out of some hundred and odd comets which have been observed, only two or three have been alleged to return, and these two or three he attempts to show, by strong mathematical argument, cannot be *proved* to have returned at all. Professor Encké, a German astronomer, as I see from the *Magazin der Auslandischen Literatur*, has discovered what he calls a comet that returns every three years, and has been now seen either twice, or thrice. It remains, however, to be proved, I think, that this is really a comet, and not a planetary body, like Ceres, Juno, or Vesta. Nothing, therefore, is proved by this, and Mr. Cole seems to have by far the better of the argument. I think, that when any half-dozen out of a hundred comets are proved to return, it will be time enough to maintain the orthodox doctrine; but as the return of none has yet been well proved, I must beg leave to be considered, for the present, a heretic.

The orthodox doctrine is, that comets run their course in a long oval, called by geometricians an

ellipsis, as in fig. 3. Mr. Cole's opinion is, that the path of comets is in the form of the figure called an *hyperbola* by geometricians, as in fig. 4; and that they

Find no end, in wandering mazes lost—*Milton*.

while they travel about through the infinite systems of stars and suns, without necessarily returning, and help, under the guidance of Providence, to balance any irregularity caused by complicated attractions. I do not say Mr. Cole is right in this, which is somewhat like the old opinion of Descartes, but I think it is, at least, more plausible and rational than the orthodox doctrine about comets.

I am sorry to see, in Mr. Cole's otherwise sensible and clever little book, such nonsense as—"Light consists of solid particles of matter, projected from the sun:—As light is neither a fluid itself, nor a mode of motion in any fluid, it must, necessarily, consist of solid particles." I ask—Why? Does Mr. Cole say that all things are either fluid or solid? Then, I ask him whether *spirit* is fluid or solid? No, no, Mr. Cole; this will not do in the 19th century: it is too monkish: we want plain sense now, and not words without meaning. Mr. Cole, however, has an equal right, I think, to say that light consists of *solid* particles, as our orthodox and mystical philosophers have to talk about the electric, the galvanic, and the magnetic *fluids;* that is, no right at all: for nobody can prove that these have the slightest resemblance to either fluids or solids. I most sanguinely hope, that the spirit now abroad among the people for useful knowledge, will put a final end to all this solemn absurdity; and that your spirited little work will be one of the keenest and most deadly weapons for its destruction.

I am,

Your's, &c.

James Rennie.

London, 28th April, 1824.

ON THE DISCOVERIES OF SIR ISAAC NEWTON.

(Continued from page 302.)

The discoveries of Newton in the science of optics were no less remarkable than those which he had made in the pure mathematics. It is true, that, by the invention of the telescope and microscope, very important additions had been made to the practical parts of this science, but it was by his experiments and researches which began in 1666, that the most wonderful properties and laws of light were made known. With the view of improving the telescope, by making the figure of the glasses different from the spherical, he had procured a glass prism, and commenced a series of experiments, which led to the discovery of the different refrangibility of the rays of light. Having admitted a beam of light into a dark room through a hole in the window shutter, and allowed it to fall on a glass prism, so placed as to throw it on the opposite wall, he was equally surprised and delighted to behold the briliancy of the colours in the image of the sun-beam, and the curious change in its figure, which, instead of being circular, as he expected, was oblong in the direction perpendicular to the edges of the prism, rounded at the two ends, and nearly five times as long as it was broad. He could only account for the lengthening of the image, by supposing that some of the rays of light in passing through the prism,

were more refracted than others, and in such a manner, that though they were parallel when they fell on the prism, they diverged from each other after refraction, and that the rays which differed in refrangibility, differed also in colour. The spectrum, or image, appeared in this way, to consist of a series of circular images, partly covering, and partly projecting beyond one another, from the red or least refrangible rays, in succession, through the orange, yellow, green, blue, and indigo, to the violet, or the most refrangible.

To bring this experiment, however, to a stronger test, he admitted the light, and applied a prism as before, but received the coloured spectrum on a board, which was placed at the distance of about 12 feet from the shutter, and pierced in like manner with a small hole. The coloured light which passed through this second hole, was made to fall on a second prism, and then received on the opposite wall. By this means, he found that the rays which were most refracted by the first prism, were most refracted also by the second, though no new colours were produced. "So," says Newton, "the true cause of the length of the image was detected to be no other than that light consists of rays differently refrangible, which, without any respect to a difference in their incidence, were, according to their degrees of refrangibility, transmitted towards divers parts of the wall." He also observed, that when the rays which fell on the second prism were all of the same colour, the image formed by refraction, was truly circular, and of the same colour with the incident light.

By this second refraction, so to speak, the breadth of the spectrum was greatly diminished, though it had nearly the same length as before; and the light at each point being rendered more free from shade, the boundaries of the different colours were more accurately traced. In this way, Newton was enabled to measure the extent of each colour, and by taking the mean of a great number of measurements, he assigned the following proportions of the whole length of the spectrum, supposing it to be divided into 360 equal parts, to the different colours of which it is composed:

The Red rays occupy	45	parts.
The Orange,..........	27	do.
The Yellow,...........	48	do.
The Green,...........	60	do.
The Blue,.............	60	do.
The Indigo,...........	40	do.
The Violet,...........	80	do.

Such were the experiments by which this illustrious philosopher at first

"Untwisted all the shining robe of day,"

and disclosed to our wondering sight, the texture of the magic garment which nature has so kindly spread over the surface of the visible world. From these experiments it was proved, that colours were not qualities which light derived from refraction or reflection, but were original properties connected with the different degrees of refrangibility belonging to different rays; because the same colour is always joined to the same degree of refrangibility, and conversely, the same degree of refrangibility to the same colour. Though the seven colours above mentioned are the primary and simple colours, yet it was found that any one of them could be produced by a mixture of different colours. For example, a mixture of yellow and blue constituted green; of red and yellow, orange; and generally, a mixture of any two colours not very far distant in the spectral range, compounded the colour in the middle between them. Newton, however, discovered what wa

surprising composition of ely that of white, which is luced by one kind of ray, the mixture of all the co- that proportion in which ist in the solar spectrum. ite light of the solar rays separated into the seven olours; and if these colours nited they form the white; ny of them be wanting, or ient in its just proportion, e produced is defective and .

on also showed, by satis- experiments, that natural of whatever colour, when by simple light of one kind seen of the colour of that ne, and that the light is anged by the colour of the om which it is reflected. is analysis and re-composi- light, which had been so sidered as simple and un- ded, he proceeded to ap- same explanation to the na of the rainbow, which, plendour of its colours, and nificence of its arch, has ally the admiration of the nd the philosopher in every had been ascertained long at the machinery which na- loyed in the construction of liant arch, was two refrac- l one reflection of the rays n, and it only remained to the nature of the colours r distribution. It was evi- at the colours in the rain- re the same as those ex- y the prism, and that they d in the same order; hence e was the same in both. in his Book on Optics, the truth of the principles laid down, by calculating it of the arch, the breadth oloured bow, the position condary bow, its distance primary bow, and by explaining the nature of the inversion of the colours. To pursue, however, all his investigations, into the nature of light and colours, would be a long, though an agreeable task, and as our space is limited, we must hasten to a conclusion.

Light had, in consequence of the views which his discovery of its nature afforded, become, in the hands of Newton, the means of making other important discoveries respecting the internal and chemical constitution of bodies. By experiment and calculation, he ascertained the ratios of the angles of incidence and refraction for different substances, and hence their attractive power with respect to light. He found that the measure of the refracting power of transparent bodies is nearly proportional to their density, with the exception of those which contain much inflammable matter in their composition, which is always accompanied with an increase of refracting power. And, having found this greatest in the diamond, he conjectured, what has since been so fully verified by experiment, that it was at least in part an inflammable body. Observing also that the refracting power of water was great for its density, he concluded that an inflammable substance entered also into its composition, a conclusion that has since been confirmed by one of the most certain but most unexpected results of chemical analysis. Newton's new theories of light and colours met with considerable opposition from some of his cotemporaries, who treated his discoveries with a degree of asperity and a want of candour very unbecoming in men who assumed the title of philosophers. Though he replied to them, however, with such calmness, modesty, and truth, as completely to silence his opponents, yet it was productive of such disagreeable feel-

ings in his mind, that he ever after was very unwilling to publish his discoveries; and indeed it was owing to this reserve, thus unhappily produced, that his inventions and discoveries were sometimes disputed, though he might easily have prevented it by timely publication.

The third book of his work on Optics concludes with those celebrated queries which carry the mind so far beyond the bounds of ordinary speculation, though still with the support and under the guidance of direct experiment or close analogy. They are a collection of propositions relating chiefly to the nature of the mutual action of light and of bodies on each other, such as seemed to the author highly probable, yet wanting that complete evidence which might entitle them to be admitted as established principles. Such enlarged and comprehensive views, so many new and bold conceptions, were never before combined with the sobriety and caution of philosophical induction. The anticipation of future discoveries, the assemblage of so many facts from the most distant regions of human research, all brought to bear on the same points and to elucidate the same questions, can never be sufficiently admired. At the period they appeared, they must have produced a wonderful sensation in the philosophic world, unless indeed they advanced too far before the age, and contained what the comments of future times were yet required to elucidate.

Newton, in these queries, first started his ideas concerning the elastic ether, which he conceived to be the means of conveying the action of bodies from one part of the Universe to another, and to which the phenomena of light, heat, and gravitation, are to be ascribed. Here he first gave his conclusions respecting that polarity or peculiar virtue residing in the opposite sides of the rays of light, which he deduced from the enigmatical phenomena of doubly refracting crystals. Here, also, he made the first step towards the doctrine of elective attraction or chemical affinity, and to the notion that the phenomena of chemistry as well as of cohesion depend on the alternate attractions and repulsions existing between the particles of bodies at different distances. The comparison of the gradual transition from repulsion to attraction at those distances, with the positive and negative quantities in Algebra, was first suggested here, and is the same idea which was afterwards expanded into such a beautiful and complete system by the ingenuity of Boscovich. Many who have attempted such flights of intellect, have ended in the vagaries of mere fiction and romance. It is only for such men as Bacon, or Newton, to soar beyond the region of mere poetical fancy, and still keeping sight of probability, at length to alight safe on the stable territory of philosophic truth.

(To be continued.)

SOLUTION OF THE CLOCK QUERY.

Mr. Editor,—The following is a solution of the first of the queries, proposed by Rusticus, at page 286, Number XVIII.

With any convenient radius, describe the circle *m c b h a*, (fig. 5,) representing the dial-plate of the clock. From the centre *o*, draw the radius *o h*, representing the hour hand, at nine o'clock. Draw also the radius *o m*, at right angles to *o h*, representing the minute

it nine o'clock. Produce *m o*, meets the circumference, in *c*; gle *c o h* is a right angle. It lent, that the hour and minands cannot again be at right to each other, until the miand has described an arc of rcle, greater than the semi*m c*. Let the excess be the . Draw the radius *o b*; and, ht angles thereto, draw the *o a*, then will the radius *o a*, present the hour and minute respectively, when they are, first time, after nine o'clock, it angles to each other.

v, the angle *c o b* is equal to igle *h o a*. For, the angles *h o c*, are equal to each other, of them being a right angle; ie angle *h o b* is common to Take away the common *h o b*, from each of these , and the remaining angle in the one, will be equal to emaining angle *b o c* in the Hence, the arcs *h a*, *c b*, are the measures of the equal *h a*, *c b*, are equal to each

ause the minute hand makes olutions of the dial-plate, in me in which the hour hand one revolution; the time in the minute hand will describe c *c b*, will be $\frac{1}{12}$th of the time in which the hour hand will describe the arc *h a*, which is equal to the arc *c b*.

Let $x =$ the number of minutes in which the hour hand will describe the arc *h a*, then $\frac{x}{12}$ will be the number of minutes in which the minute hand will describe the arc *c b*. But the minute hand describes the semi-circle *m c* in 30 minutes, and it describes the arc *m c b* in the same time in which the hour hand describes the arc *h a*. Hence $x = \frac{x}{12} + 30$; that is, $12\,x = x + 360$, by Reduction; and $11\,x = 360$, by Transposition and Subtraction; whence, by Division, $x = \frac{360}{11} = 32\frac{8}{11}$. Hence, the first time that the hour and minute hands will be at right angles to each other, is at $32\frac{8}{11}$ minutes past nine o'clock. And because they will be at right angles to each other, at the end of every $32\frac{8}{11}$ minutes, therefore, $32\frac{8}{11}$ minutes $\times\ 16 = 523\frac{7}{11}$ minutes $= 8$ hours and $43\frac{7}{11}$ minutes, is the time, after nine o'clock, when they will be at right angles to each other for the 16th time; which is at $43\frac{7}{11}$ minutes past five o'clock.

Your's, &c.

J. D. C.

Glasgow, 5th May, 1824.

ARCHIMEDEAN QUERY SOLVED.

,—In what follows, I have pted to give an approximate r to the query of R. G., at 188, Number XII.; and, if ppositions that are made, be the truth, the result gives a fine illustration of the wellmaxim in Mechanics, *viz.* t what is gained in power is time."

calculating, from the data given at pages 232 and 233, under the article "Geodesic Operations," the circumference of the Globe, supposing it a perfect sphere, will be about 24,923 miles, and its diameter 7933.22 miles. Hence its solidity is 261,425,569,797 cub. miles, or 1,425,233,647,205,609,472,000 cubic yards: and, if we suppose each cubic yard to weigh 3000 lbs., (which, at a mean rate, I think is

too little,) the weight of the globe will be 4,275,700,941,616,828, 416,000,000 lbs.

If we now suppose this weight to rest upon, or be suspended from, the extremity of the shorter arm of what is termed a lever of the first order, and counterpoised by a man exerting a force, equal to a weight of 100 lbs., at the extremity of the longer arm, the length of this arm will be to the length of the arm that sustains the weight, as 4,275, 700,941,616,828,416,000,000 is to 100; or, by dividing both by 100, as 42,757,009,416,168,284,160,000 to 1. And, if the weight be raised a perpendicular height of six inches, by pulling, or forcing down the extremity of the longer arm of the lever, its perpendicular descent will be 42,757,009,416,168,284,160, 000 times six inches = 256,542, 056,497,009,704,960,000 inches.

What remains is to ascertain the time in which the extremity of the longer arm of the lever would descend through this space, supposing it were pulled down with the same velocity with which a stone falls freely towards the earth, from a height near the earth's surface—that is, with the same velocity, as that with which a body would move from rest, when acted upon by a constant force, and which describes, in the first second of time, a space equal to $16\frac{1}{12}$ feet, or 193 inches.

It can be demonstrated, that when a body moves from rest, by the action of a constant force, whatever space it describes in the first second of time, it will describe four times that space in two seconds; nine times that space in three seconds; sixteen times that space in four seconds, &c. &c. That is, the spaces described are as the squares of the times. If, therefore, the perpendicular descent, *viz.* 256,542, 056,497,009,704,960,000 inches be divided by 193, the quotient 1,329, 233,453,352,381,890,984 is the square of the time; the square root of which being extracted, gives 36,458,654,025 seconds = 1156 years, 35 days, 3 hours, 53 minutes, and 45 seconds for the time of descent.

In these calculations I have, in most instances, rejected remainders, and supposed 365 days to a year.

I am, Sir, your's, &c.

J. D. C.

Glasgow, 23d April, 1824.

REPORT OF THE EDINBURGH SCHOOL OF ARTS.

Close of the Mechanical Philosophy Class.

On Tuesday evening, Mr. Buchanan, civil engineer, finished his course of lectures on mechanics in this institution. The subject, on this and the preceding evenings was that of the steam engine, the principles and construction of which he illustrated by a variety of striking experiments and models. Having first explained the general principles of the engine, and shown the action of the elastic fluid, and the different methods of applying it by means of a small engine, with a piston working in a glass cylinder; he then considered the laws of the formation and condensation of steam, which last effect was shown by bringing the steam into contact with cold water, a large body of which was instantly, in a manner, swallowed up within the steam vessel, by the power of the vacuum created by the condensation. He also showed a small model of a high-pressure engine, made, by way of amusement, by a youth of this city, all whose instructions in the principles of mechanics, have been received in this institution. He then took a view of the successive steps by which the steam engine had risen to its present perfection. First, showed a model, on a pretty large scale, of what the Marquess of Worcester, about the middle of the 17th century, termed his "Stupendous Water-commanding Engine," the raising of water

ie mines, forming, at that period, at object of practical mechanics. incipal parts of this model being , the whole effect was distinctly d, and instead of the pressure of which would have broke the glass Mr. Buchanan employed the of condensed air, which produces y same effect, and threw, in this continued stream of water to a height in the hall. He then a similar model of Captain 's engine, and of the improve- which he introduced. Then came nd improvement of Newcomen, roduction of the piston and cylin- e effect of which was illustrated glass model already mentioned. he explained the memorable dis- of Watt, and showed a complete of an engine of four-inch cylinder, ght-inch stroke, constructed by Neilson, engineer, Glasgow, and forms a very beautiful piece of ery. No material improvement, then observed, has been made steam engine since the time of But he made some interesting s on the subject of high-pressure pansive engines—mentioned a very ant fact on this subject, which he imself established by numerous nents—stated the same reason for g the advantages of Perkins' en- hich he had expressed last year, at, since then, he had seen no s for altering his opinion, but re- that the time did not allow him ll longer on this attractive subject. remarks well deserve the attention ineers, and we hope Mr. B. will nicate them to the public. After ulating shortly the principal to- hich had engaged their attention the course of the session, and generally, the views which had him in the execution of the task which he had been entrusted, he ded his short but impressive ad- with saying, that he felt deeply l to the students for the attention which they had honoured the pre- course of lectures—he might ay, that whatever might have been leficiencies, these could, in no re- e ascribed to any want of zeal for nstruction; and if he had contri- in any degree, to their improve- or the success of this excellent in- on, it would always be to him a of pride and satisfaction—adding that he would still be happy to afford them every information in his power, and that the name of a student in this institution would always be a claim to his attention and regard. Mr. B's ad- dress was received with every mark of respect and approbation by a crowded audience.

Close of the Mathematical Class.

On Wednesday evening, the Reverend Andrew Wilson closed the third session of the school, and, in doing so, addressed a few words to the students. He was aware that there had been many imperfections in his mode of teaching mathematics, though he assured them there was no lack of zeal. There were many difficulties to contend with, which would, in the course of another year, he trusted, be, in a great measure, removed, by the adoption of a mode of teaching more adapted to the peculiar circumstances of that institution. They had accomplished less this session than the last, partly from unforseen interruption, and partly from the time being confined to six, instead of seven or eight months. He had endeavoured to remedy the defects of the schools, in teaching the principles of arithmetic, by making his instructions applicable to the common business of life. Algebra next occupied their attention, and, from its being to many a new study, took up a considerable portion of their time. There was a prevalent opinion that there was something mysterious and complex attendant on this study; that was, indeed, a mistaken idea, for its truths were suited to the meanest capacity. Algebra had been decried by some as a mere mechanical operation. This, however, was not the case. It required an exertion of intellect to bring questions under the dominion of this science. They had learned but a few of its applications, but as they proceeded in their studies they would be better able to appreciate its utility. Geometry had, also, formed a part of their studies, and by the introduction of palpable symbols in his demonstrations he trusted he had enabled them to comprehend that science more clearly than he could have done otherwise. In the second class, trigonometry, with its several applications to surveying, levelling, &c. had formed the chief subjects of his prelections. The construction and use of that useful instrument the sliding rule, had, likewise, been explained. In both classes the

exercises had displayed a degree of talent which did great honour to the students, and augured well of their future attainments. He should ill express his feelings if he did not say that he felt proud of the display of national character which had been exhibited by the attendance in the School of Arts. Considering that the greater part of the students came there after great bodily and mental exhaustion, to study the truths of abstract science, the sight he frequently beheld was one which would have rejoiced the hearts of the philanthropist or the patriot. It was a convincing proof that the high spirit of their forefathers was not extinct in their children, and more signal triumphs in the world of science were to be anticipated. In surmounting the many obstacles which hindered their advancement in knowledge, they had given an earnest of what might yet be attained. If by attending the School of Arts, they had acquired a taste for scientific study, more had been gained than if he taught all the mathematical learning of both ancients and moderns. Though the seed sown was small, yet it might produce a great tree. They must be all aware, that before they could clearly understand mechanical philosophy, construct instruments, or perform experiments, they must become acquainted with mathematics. Their attendance would turn out to their advantage, for labour was not lost in mental improvement; while they proceeded in their studies, they were improving their understanding, training their minds and giving decision to their character.

The mathematical classes, we understand, were not so numerously attended as the others—there was no amusement to attract—nothing but hard study; four hours a-week were devoted to these two classes, in which there might be nearly 200 students. The teacher had no sinecure, and his pupils seemed to be sensible of the obligations under which they lay for his unwearied exertions. Twenty prizes of books were awarded, besides the silver medals, gained by Mr. James Forrester and Mr. John Hastie.—*Caledonian Mercury.*

MISCELLANIES.

Progress of Knowledge.

A public meeting has been held at Kendal, for the formation of a "Mechanics' Institution and Apprentices' Library," and it promises to be early set on foot. We have little doubt but the example given by *Glasgow and London* in this way, will extend to the principal towns in Britain; and then, perhaps, we may calculate that, in regard to science and general enlightenment, the Mechanics and Artisans of this country will become a most powerful and influential body. Would that we had a second Bacon to witness and aid the practical illustration, on a large scale, of the immortal saying of the first—"Knowledge is power!"—*Examiner.*

Scientific Minuteness.

The celebrated French naturalist, Cuvier, has dissected an insect, not an inch long, in which he reckons *four hundred and ninety four* muscles, connected with *four hundred and ninety four* pairs of nerves, and *forty thousand* antennæ.

Royal Society of London.

On the 28th of last month, at a general meeting of the members, Charles Mackintosh, Esq. of Crossbasket, was elected Fellow of this Society.

NOTICES TO CORRESPONDENTS

We must defer till next week.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed.

J. CURLL, PRINTER.

THE GLASGOW

MECHANICS' MAGAZINE.

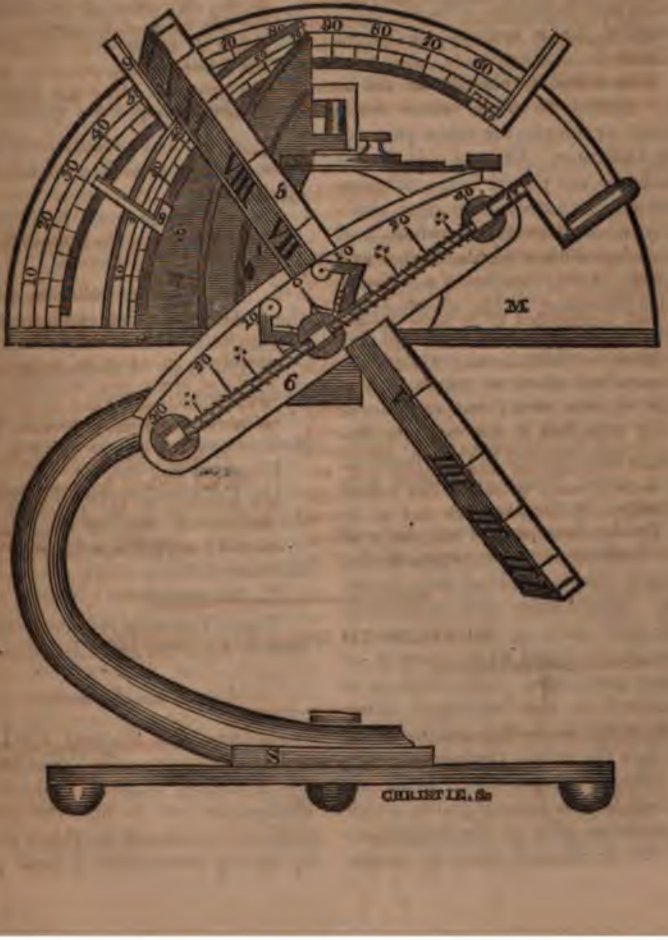
"Ah! who can tell the triumphs of the mind,
By truth illumined, and by taste refined?
When age has quenched the eye, and closed the ear,
Still nerved for action in her native sphere,
Oft will she rise—with searching glance pursue
Some long loved image vanished from her view!"—*Rogers.*

No. XXI. *Saturday, 22d May,* 1824. Price 3*d.*

ORIGINAL BUT DISPUTED INVENTION.

Mr. HUNTER'S NAUTICAL INDICATOR.

ELEVATION.



DESCRIPTION OF THE NAUTICAL INDICATOR,

FOR FINDING THE

Latitude, Longitude, and Variation.

Invented by Mr. JAMES HUNTER, Member of the Glasgow Philosophical Society.

[Communicated by the President.]

THE Indicator consists of a stand supporting a circular plate of polished brass, about 14 inches in diameter, representing the horizon, and marked and numbered accordingly, with the proper divisions. This horizon is surmounted by a semi-circular plate, as a meridian, set at right angles to the plane of the horizontal plate, properly divided and furnished, with an index attached to a nonius, indicating minutes.

This meridian plate is cut out at the centre, to allow room for a pivot, or hinge, for other parts of the Indicator. On one side of this meridian, are placed two quadrants, and on the other side one; similarly divided as the meridian, and furnished with a similar index and nonius. These quadrants are moveable on a pivot, or hinge, rising perpendicular from the centre of the horizontal plate; or, agreeing to this centre, they are singly moveable on the pivot, but capable of being attached at any relative distance, and retained in that situation, by a screw, binding together tails attached for the purpose.

To the East and West points of the horizontal plate, is attached a horary circle, divided into hours, &c. This horary circle represents the daily path of the sun, and it may be furnished with a nonius, as other parts are. This circle is so attached to the horizontal plate, that it can be moved parallel to it, to suit the sun's declination; this is effected by the circle being attached to two tangent plates, which *by grooves* slide on the projections *from the horizontal* plate, by means of screws passing through and working in these projections, and carrying the tangent plates, and with them the horary circle, to the degree of the sun's declination. This degree is indicated on a scale of tangent divisions on the tangent plates, and as such tangents are of various lengths, an expanding *Vernier* is used to adjust them. Its expansion is effected by friction wheels and springs working against a proper curve.

References to the Figures.

1, 2, 3, The quadrants of altitude, and also arches of azimuth circles.

4, Is the apparent horizon, on which the azimuths and amplitudes are given.

5, The horary circle, on which the hours and minutes of time are given.

6, The scale of declination, with an expanding Vernier.

7, 8, 9, Sliding indexes, with their respective thumb-screws.

10, A sliding-stop.

11, The continual screws for setting the indexes of declination.

S, The support, on which the instrument turns.

M, the meridian.

Note—The same references agree both to the Plan and Elevation.

Use of the Indicator.

Its use is to discover the Latitude, Longitude, and Variation of the Compass, without a meridian observation; or to find the whole path of the sun and the ship's place, by having ascertained a small por-

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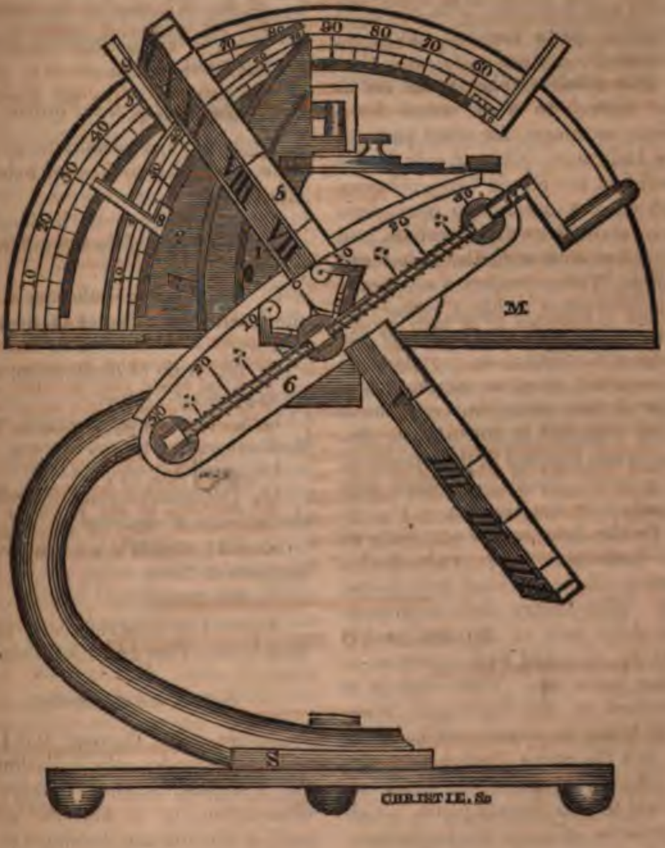

duction into practice by his influence.

(Signed) JAS. WATT, M. D.

8th November, 1817.

In 1818, Mr. Hunter, for this invention, was awarded "Coulter's Premium," by the Lord Provost, Dean of Guild, and other assessors, for whom the above description was written by our late esteemed townsman, Dr. James Watt.

More than once has it been our melancholy duty to assert the claims and to publish the inventions of unrewarded genius, and we are sorry to say we must add those of Mr. Hunter to the number. Notwithstanding the priority of his invention, it will be seen, from the following correspondence between the Inventor and a Gentleman of this city, that this priority is not only thrown aside, but any benefit that might arise from it, is by right of patent, likely to pass into the hands of another. We hope the publication of the invention itself, which is evidently the same as that referred to in this correspondence, will have the effect of rendering the patent null and void with respect to the second inventor, and of causing the reward due to it to be given to the original inventor. The East India Company, to whom the invention was submitted, must be aware of the priority of Mr. Hunter's claims, and we trust that they will give that award respecting them which justice requires.

LETTER No. I.

To Mr. R—— H——, Cumberland Court, Glasgow.

London, 26th November, 1823.

DEAR SIR,—* * * You may have read, in the London Magazine of the present month, Nov. 1823, p. 556, that a patent, taken out by *Mr. Joseph* Bordwine, a Professor *in the East* India Company's service, threatens to annihilate all my expectations of getting any benefit from the invention of the Nautical Indicator. To counteract this, Mr. Duncan is taking a decided and active part in my favour, and suggests the necessity of collecting as many documents as can possibly be obtained in my behalf, to prove my right as the original inventor; for which purpose I solicit your well-tried friendship, to procure and send by the earliest post—the Glasgow Courier of Tuesday, December 9th, 1817, in which is detailed the opinion of the valuable and learned Philosophical Society of Glasgow, with the attestation of Mr. John Cross, of the Glasgow Observatory, contained in that paper, and any other corroborant testimony you can acquire on the subject. * * *

I conclude with, Dear Sir,

Your fervent well-wisher,

JAMES HUNTER.

LETTER No. II.

To the Same.

London, 9th Dec. 1823.

DEAR SIR,—Your satisfactory letter of December 2d, came to hand on Friday; and Saturday was both cold and rainy, which you may believe did not retard my locomotive progress. Called at Nelson-Square for Mr. Robert Ostill, who was in the country; twice at the Patent Office, Chancery-Lane, and was informed that Mr. Bordwine's patent is not yet enrolled; and, on reading your letter, the clerk observed, that he thought Mr. Bordwine could not support his claim to the invention. * * *

The two instruments on board the Company's ships were made for me, and, by the order of the Shipping Committee, put on board two of their ships, *Waterloo* and *Scaleby Castle*, which will not arrive at London before the ensuing

summer; hence, I am reduced to inactivity and its consequent attendants until that period.

Some other projections, "*I believe known to you*," must therefore be left unattempted, through want of means to prosecute them; but which, from experiments made, are sufficiently proven to be practicable, and of great utility to mankind. If you, my dear friend, should think that a few of your acquaintances would unite to forward such intention, it would require no great capital to establish such a manufactory. The purpose is to substitute manual power for the use of horses, which would be a great benefit to the industrious poor, and an equal advantage to the agriculturist, and may be applied to every purpose in which an active power is necessary. I pretend not to say that I have discovered any new power in nature; but the manner of application alone, I conceive to be new, and is capable of being increased or diminished, multiplied or divided, as necessity and the number of hands shall demand—and this in 30″ of time. Time will not permit farther specification, but I should be happy to have an opportunity of entering more fully into the merits or defects of such an improvement along with you. * * *

I am, Sir,

Your's sincerely,

JAMES HUNTER.

We subjoin the following account of this invention, alluded to in the above correspondence, that our readers, and the public in general, may have it in their power to compare it with the preceding, and thereby be certified that the invention of Mr. Bordwine is identically the same as that of Mr. Hunter.

"VALUABLE DISCOVERY." [INVENTION.]—*Instrument for finding the Latitude, at once, without the help of Logarithms or Calculations, from two observations, taken at any time of the day.*

The inventor of this instrument, Joseph Bordwine, Esq., Professor of Fortification at the East India Company's Military College at Addiscombe, has taken out a patent for his discovery, and the Court of Directors have issued orders that this instrument be henceforth used throughout the whole of their naval department. Mr. Bordwine's nautical instrument is intended to put within the reach of every commander of a vessel, the solution of that important problem in navigation, *viz.* the determination of the latitude by two observations of the sun, or other celestial body, taken at any period of the day, a problem which has engaged the attention of scientific men for a long time past, with the view of rendering the forms of calculation more simple than they are at present. The instrument does away with calculation altogether, giving the results in itself. It is formed of four circular arcs, (the greatest about nine inches in diameter,) having a common centre, and traversing about each other. On two of these are scales for the declination of the object observed, and on the other two, scales for the altitudes, which are taken by the usual instruments, quadrant, &c. There is also a fourth semi-circle, fixed in position, for the time elapsed between the observations. In working it, the declination for the day is set off, the time adjusted,—and the verniers, marking the observed altitudes, brought together, when the instrument will immediately show,

1, The latitude of the place of observation, to 15″ of a degree.

2, The distance in time from noon of either observation, to 2″ of time, which compared with a chronometer will give the difference of longitude.

3. The true azimuth, which, compared with a compass bearing, will give the variation of the magnetic pole.

The operation may take about three or four minutes, there being no other calculation required than the usual corrections for dip, refraction, &c. in the altitudes; and the like for the declination from the Nautical Almanack, to adapt it to the place of observation: these being reductions which must take place under any solution of the problem, whether by the calculated forms, or by instrument.

Two or three hours' instruction will make any master of a vessel competent to use it.

London Magazine, Nov. 1823.

This account of Mr. Bordwine's instrument, in our opinion, amounts almost to a demonstration that it is the same as Mr. Hunter's, and, in leaving the subject, we again express our hopes, that the Directors of the East India Company will, in this case, (as indeed we have no doubt but they will,) act according to the loud calls of justice and honour.

ON MR. HALL'S NEW AND IMPROVED PROCESS OF SINGEING MUSLINS.

SIR,—Having read in your Magazine of 8th instant, a letter, signed N. P., ON A NEW & IMPROVED PROCESS OF SINGEING MUSLINS, which he describes as being done by the flame of gas; and as he expresses a wish to be informed *whether or not a Patent has been taken out for this process,* I beg leave to inform him that I took out Patents for England, Ireland, and Scotland, in Nov. 1817, for the process of Singeing by the flame of inflammable gas, by whatever modification of machinery it might be done; and also, that I have taken out other Patents for England, Ireland, and Scotland, last year, for an improvement upon my first Patents, the object of which is to make the flame effectually penetrate into, or impinge upon the goods to be singed, so as to divest them most perfectly of all fibre, rendering them clear and transparent, and giving cotton goods the appearance of articles manufactured from linen. I have already formed an extensive establishment at Salford, Manchester, where I have now eight machines fully at work, and I am at this moment treating for premises at Glasgow for the same purpose. N. P. may satisfy himself of the fact of my having taken out the above-mentioned Patents, by application at the Patent-offices of the United Kingdoms; and if he will communicate to me through your medium, or any other he may prefer, the name of the person who is singeing as he describes, I will introduce the "Bugbear" to him, that he may see how he likes his acquaintance. I beg farther to add, that my Patent of 1817, has undergone the ordeal of a Court of Justice. I brought an action against Francis and Jarves Boot, of Nottingham, for an infringement, which was tried in the Court of King's Bench, on 19th Dec. 1822, when a verdict was given in my favour, and the validity of my Patent established. I shall very soon have the pleasure of showing you my Patent Machinery at work at Glasgow, with which, I have no doubt, you will be much pleased, as it gives such general satisfaction at Manchester; and as I am coming to Glasgow next week, I shall do myself the pleasure of having a personal communication with you.

SAMUEL HALL.

Basford, near Nottingham, May 15, 1824.

SOLUTION TO THE QUERY RESPECTING THE MEASUREMENT OF A DEGREE.

MR. EDITOR,—No solution to the problem in No. XV. under the article Geodesic Operations, having yet appeared, I have sent you the following:

The zenith distance of the star at the first station, is $90^\circ - 47^\circ\ 12' = 42^\circ\ 48'$; and at the second, $90 - 46^\circ\ 7' = 43^\circ\ 53'$. Therefore, $43^\circ\ 53' - 42^\circ\ 48' = 1^\circ\ 5'$ = diff. zenith distances.

Now, to find the length of a degree from this measurement, the rule is: As the celestial arch = difference of the zenith distances of two stars : is to one degree :: so is the measured interval : to the length of a degree in the same measure. Hence, $65' : 60' :: 75$ miles : $69\frac{3}{13}$ miles = the length of a degree. Now, $360^\circ \times 69\frac{3}{13} = 24923\frac{1}{13}$ miles, the circumference of the earth. And, the diameter of a circle being to its circumference as 1 to 3.1416; therefore, $24923\frac{1}{13} \div 3.1416 = 7932.22$ miles, the diameter.

The following question is of the utmost importance to Mechanics:

A water-mill is to be built where the current of water has a fall of 20 feet, or perpendicular descent; the engineer desires to know the diameter of the water-wheel, so that the power or force it shall receive from the issuing water may be the greatest possible.

A. W.

Rothesay, 5th May, 1824.

A solution to the above query, on the measurement of a degree, was also given by J. F., but as it required a figure, the above was preferred. W., of Lanark, is quite wrong in supposing it to be indefinite, or that the earth might be of any size. He has mistaken the angles, and has taken an obtuse angle instead of an acute one.

ON OUR BARBAROUS MIXTURE OF THE DIFFERENT STYLES OF ARCHITECTURE.

SIR,—I certainly agree with your Correspondent, Mr. Capital, in opinion, that the study of the remains of ancient architecture, particularly that of the Grecian, is the only way of acquiring an accurate knowledge of the art. The Greeks, indeed, may well be styled masters of architecture, as they not only surpassed all that went before, but they have baffled every attempt at successful rivalry since. They did not, like the Romans, dilapidate one building to beautify another; indeed, it was no uncommon thing to see in Rome, columns of one or more temples, side by side, in the colonnades of another. We have not yet gone such lengths, though we often see mixtures of the Grecian and Roman styles in one portico, and that without any cause or necessity.

It is with unfeigned regret, I observe, in a portico recently erected in Clyde-Street, that the artist, in place of following the same simple Grecian design which terminates the other end of the same compartment, as he ought to have done, has given another design, with angular volutes in the capitals of the two centras columns, and over the antæ, at the angles, plain volutes, with dissimilar faces, which is the very reverse of what they should have been, in-

dependent of the difference of style. There is another tetrastyle portico near the top of St. Vincent-Street, with bases, capitals, and astragal of the Roman Doric order, and the shafts fluted with arris flutes, which belong only to the Grecian Doric and no other.

Some artists, in place of studying the works of the great masters, and profiting by them, strike out a new path for themselves, and falling into the opposite extreme, take novelty for merit, and singularity for beauty. Hence proceed many of those abortions with which our streets are encumbered. These few remarks may, perhaps, be unpleasant to some, and may be deemed unnecessary by others, but literature has been improved by the tormenting ordeal of criticism, and why may not the works of science and the arts be improved by the same means?

DEMETRIUS DOORWAY.

ORIGINAL BUT DISPUTED INVENTION.
MR. HUNTER'S NAUTICAL INDICATOR.

PLAN.

CHRISTIE. Sc

See the Description in this Number, page 322.

NT OF Mr. WALKER'S NEW MUSICAL INSTRUMENT CALLED THE CELESTINA.

Editor,—I felt much the flattering notice you ny Astronomical Lecture uranion in Glasgow, in ond Number, and have asure in communicating nation sought by 'Har- respecting the Celestina. right in supposing it "a ument;" it is only an Harp- ith a thread of silk (touched dissolved in spirit of wine) over it, so that the keys hed, the jacks, with small eels on them, press the silk against the wires, draw out their tones. n thread is made to revolve by a wheel and treadle on the left side of the instrument, and the two ends of the silk band are finely sewed together.

Any air or tune may be played, and it certainly has a sweet effect as the curtain rises, and displays "the silent spheres." The honour of the invention of the Celestina, Eidouranion, and your fine Revolving Light-Houses in Scotland, is due to my father, Adam Walker.

I am, Sir, with many wishes for the success of your useful labours,

Your obedt. Servant,

D. F. Walker.

London, 24th April, 1824.

N THE DISCOVERIES OF SIR ISAAC NEWTON.

(Concluded from page 316.)

ful as the discoveries were this young philosopher had nalized himself, they were o be outshone by the most of the whole. Scarcely ached the age of twenty- n, by the occurrence of a lic calamity, he was forced nto the country, where he undation of a new science. one day alone in his garden, ed an apple falling from a e say it struck him on the l the thought occurred to e gravity is a property ot confined to bodies near of the earth, but extends s of trees, and of the high- gs, and even to the sum- loftiest mountains, with- ing any apparent change ction or intensity, may it to a much greater distance, o the moon itself? And if e case, may not the moon be retained in her orbit by gravity, and be forced by it to describe a curve like a projectile at the earth's surface?

Ere long he made a computation on this supposition, and found that the deviation of the moon moving in her orbit, from the tangent at any given point, was precisely what it ought to be, supposing the force of terrestrial gravity to vary inversely as the squares of the distances from the earth's centre. This step accomplished, it was not for a mind, such as that of Newton, there to rest. He collected from mathematical reasoning, unexceptionably demonstrated, that all bodies which are moved in any curve line, described in a plane, and which, by a radius drawn to a point, describe areas round that point, proportional to the times, are urged by forces directed to that point. And since it is agreed by astronomers, that the primary plan-

ets describe about the sun, and the secondary planets describe about their primaries, areas proportional to their times, it follows, that the force by which they are continually deflected from the tangents, and are made to revolve in curvilinear orbits, is directed towards bodies placed in the centres of those orbits.

He thus found that the three great facts in astronomy, which form the laws of Kepler, gave the most complete evidence to the system of gravitation. The *first* law, that the areas described by the radius vector are proportional to the times in which they are described, is the result of the motions produced by an original impulse impressed on a body, combined with a centripetal force, continually urging it to the same centre. The *second* law, that the planets describe ellipses, having the sun in one of the foci, common to them all, coincides with this proposition, that a body under the influence of a centripetal force, varying as the square of the distance inversely, and having any projectile force whatever originally impressed on it, must describe a conic section having one focus in the centre of force, which section, if the projectile force does not exceed a certain limit, will become an ellipse. The *third* law, that the squares of the periodic times are proportional to the cubes of the distances, is a property which belongs to the bodies describing elliptic orbits, according to the conditions expressed in the second law. Thus, the three great laws to which the astronomy of the planets had been reduced by Kepler, were all explained in the most satisfactory manner, by the single principle, that the planets gravitate to the sun with a force which varies in the inverse ratio of the squares of the distances.

Some remarkable conclusions were deduced from this discovery of universal gravitation, and such as gave a deep insight into the constitution of the planetary system in matters that seemed to be far beyond the reach of human knowledge. By its means, the quantity of matter, and even the density of the planets, were determined. Newton compared the intensity of gravitation at the surface of the earth, with its intensity at the moon; and, by a similar computation, he compared the intensity of the earth's gravitation to the sun, with the moon's gravitation to the earth; each being measured by contemporaneous and momentary deflection from a tangent, to the small arch of its orbit. By a more detailed investigation, it was found that the intensity of the central force in different orbits, was proportional to the mean distance divided by the square of the periodic time, and the same intensity being also proportional to the quantities of matter divided by the squares of the distances, it followed that these two quotients were equal to each other; and that, consequently, the quantities of matter were proportional to the mean distances divided by the squares of the periodic times. Hence, if the ratio of the mean distance of the sun from the earth, to the mean distance of the moon from the earth, be determined by astronomical observation, and the ratio of their periodic times be also known, then the ratio of the quantity of matter in the sun, to the quantity of matter in the earth is found, and the same rule is applicable to all the planets accompanied by satellites. Hence, also, their mean densities, or mean specific gravities, became known; for, from their distances, and the angle they subtended, which are both determinable by observation, their magnitudes or cubical contents were easily inferred, and the densities of all bodies are proportional to their quantities of matter divided by their

de. The *Principia* which d all these discoveries, and ed the principle of universal on, was published in 1687, on this account, which will er memorable in the history n knowledge.

immense and fertile the re- enquiry thus laid open to ld is apparent, from suc- discoveries. The earth, the d all the celestial bodies tend the sun, attract each utually. The minutest par- each of *them*, and of all dies, conform to the same nce flow a variety, not yet, aps ever to be exhausted, of ng and important proposi- Such, for example, as those elate to the attraction of spheroids, and other solids; s which retain the planets orbits, so as to conform to plerean laws; the forces isturb the elliptic motions planets and satellites; the ities of the lunar motions, e of the other secondaries; tions of the planes of the orbits; the figure of the l planets; the variations of t different points at their the tides; the oscillations mosphere; the attractions tains; the precession of the s, and the nutation of the axis; the irregular figure balancing of Saturn's ring, lependance of that balanc- that irregular figure; the of the moon;—these and re subjects of investigation om the theory of attraction, and all of them as they ued, supplying greater or irmation of "the simple me agency" of this all-mat- principle. By this prin- e philosophers, so to speak, sed the physical system of , reduced it to its single element, and recomposed it again. Viewed in this light, physical astronomy is, unquestionably, of all the sciences, the most complete, the most sublime, and that in which the human intellect is most elevated. But that which gives it, above all, an inestimable value, is its *perfect certainty*. Other branches of science have changed incessantly, and several must still undergo modifications, several perhaps be abandoned; yet whatever be the progress of knowledge, whatever be the expansion of intellect, the principle of universal gravitation is irrefragably established, and the main deductions from it rest on an immoveable foundation. Hence it is, as Dr. Chalmers has finely remarked, that "when we look on the days and the discoveries of Newton, we annex a kind of mysterious greatness to him, who, by the pure force of his understanding, rose to such a gigantic elevation above the level of ordinary men,—and the kings and warriors of other days sink into insignificance around him,—and he at this moment stands forth to the public eye, in a prouder array of glory than circles the memory of all men of former generations; and, while all the vulgar grandeur of other days is now mouldering in forgetfulness, the achievements of our great physical astronomer are still fresh in the veneration of his countrymen; and they carry him forward on the stream of time with a reputation ever gathering, and the triumphs of a distinction that will never die."

It has been demonstrated by Lagrange and Laplace, that all the planetary inequalities are periodical, each returning after a certain time, to go through the same series of changes which it had formerly exhibited; the whole system oscilating, as it were, between certain limits which it can never pass. Now, this property, so essential to

the well-being of the inhabitants of the planets, requires the concurrence of the four independent conditions; that the force shall be inversely as the square of the distance; that the masses of the revolving bodies be small, compared with that of the central body; that the eccentricities of the orbits be inconsiderable; and that the planes of those orbits be originally not much inclined to each other.

The irresistible conclusion thus furnished is, that all this is the work of intelligence and design, for a benevolent purpose; the work of a controlling and regulating *Power*, from whom all the powers of material nature emanate.

VARIOUS COMMUNICATIONS.

EASY MODE OF CALCULATING INTEREST AT FOUR PER CENT.

SIR,—If you think the following method of calculating interest at 4 per cent. (and a similar method could easily be adopted with other per cents., as three or five per cent.) worthy of insertion, I shall feel obliged by your giving it a place in your very interesting publication.

At 4 per cent. 1d. is the interest of £38 for one day, or of £1 for 38 days, nearly. This is found by multiplying 365 by 25, and dividing the amount by 20 and 12, or 240.

Make out a table as below, (which may be carried as far as convenient in a few minutes,) adding always nineteen to every succeeding number of the first column, and ½d. to every succeeding number of the second.

19	½d.
38	1
57	1½
76	2
95	2½
114	3
133	3½
152	4
171	4½
190	5
209	5½
228	6
247	6½
266	7
285	7½
304	8
&c.	&c.

Suppose a sum is given, say £233, on which interest is to be calculated, at 4 per cent., for so many days, say 217; as every pound gives a penny in 38 days, or a halfpenny in 19 days—find the *number of times* that 19 is contained in 217; which, from the above table, is 5½ times, and there are 8 days over; cast up the given sum, £233, at 5½, and the answer is the amount for 209 days, viz. £5 6s. 9½d. Then, for the odd 8 days, as £19 is ½d. in one day, see, from the table, how often 19 is contained in £233; which it is evident, is a little more than 6; multiply that by 8, the number of extra days, and the product is nearly 4s. 1d.; add this to the former result, £5 6s. 9½d., and the answer is found to be £5 10s. 10½d. This answer is not perfectly correct, but by deducting 1d. from every £7 12s. 1d. of interest thus found, it is rendered so. Hence, by deducting the ½d., the answer, £5 10s. 10d., will be correct to the nearest penny.

Take another sum, £257, at 165 days, at 4 per cent. From the table, we find 19 is contained in 165 four times, and there are 13 over; now 257 at 4d. is £4 5s. 8d. Then, 19 is in 257 about 6¾ times, which, multiplied by 13, or 1s. 1d., is 7s. 3¾d. making the whole, £4 12s. 11¾d.; from which deduct ¾d. for 1d. in every £7 12s. 1d. and the answer is £4 12s. 11d.

I trust this will be intelligible to every one who takes the trouble of perusing it with care, and, I am very confident, that it would shorten the process of calculating interest very materially.

W. C.

Paisley, April, 1824.

Our Correspondent has found, by approximation, that the radius of the circle which divides another into two equal parts, and whose centre is in the circumference of the given circle, is equal to the chord of 70 deg. 48 min. 42 sec. We shall insert his calculation on the first opportunity.

OVEMENT IN WINDOWS.

—The following plan of an Im-ent in Windows occurred to me ling over your Correspondent's nications on that subject, in Nos. and XVI. of your Magazine. ll matters which are left entirely management of servants, simpli- not in the plan, at least in the absolutely necessary; a requi-ich neither of the plans proposed ufficiently to combine;—what I propose is, simply, to make one of bars of the sash of two pieces, of one, as in the ordinary way; pieces to be fixed together with unk plate hinges, and the piece e frame of the window made with ng edges to run in corresponding made in the frame, so as to the sash from coming forward he parting rod of the other side ved. By this plan nothing more sary, when it is required to turn dow outside in, but to remove osite parting-rod, when it imme-opens inward, in the same man-a door.

plan is so simple, that it needs be hinted at, to be understood and d by any tradesman, and would, completely answer the end in without in the least altering their nce.

R. A.

ouse, May 12, 1824.

Y MODE OF SHAVING.

—As your Correspondent, Y., t you a notice of a very useful c fact, I send you another on the ubject, which is, perhaps, not ly known.

e face be well washed with soap ter, and the soap washed clean zor will cut as easily for the pa- if a profusion of lather were on , provided it be always kept wet. this hint will be of service to en who have little angry pimples r faces, and which the suds bring ight, like molehills after snow; attending to this fact, they may ar of these eruptions.

RUSTICUS.

have often tried this experiment, r as respects the washing of the fore shaving, and we can assure ho *are not aware of the fact,* that rs *the process far more* easy and agreeable. How far, however, it may be adviseable to perform the operation without lather, we are not so well prepared to say, but every one may make the experiment for himself.

ED.

ON SOUND.

SIR,—In your 19th Number, a Constant Reader wishes a cause assigned for the sound produced, when a certain kind of shell is held to the ear. My thoughts were turned to that circumstance some years ago, and I found that any small hollow vessel, with a smooth hard surface, produces a similar sound in a greater or less degree; a tea-cup for instance has this effect, but a glass goblet answers better. If the shell referred to gives a stronger sound, it is because its spiral cavity is better adapted for it, just as a trumpet sounds better than any short common tube. As to the cause, I am convinced that it is the insensible perspiration from the ear and parts around it striking the cavity of the shell, or cup, and returning upon the ear.

Your's respectfully,

G. M.

CURIOUS FACTS AND QUERIES.

SIR,—It is said by one of your Correspondents, to be edifying to communicate occurrences that offer themselves to our observation in common life, and pleasing to see them accounted for on natural and scientific principles. Agreeing most fully in this sentiment, I beg leave to state the following queries, founded on facts, that possibly others may have noticed, though I never saw them stated before.

1. In the evening, when walking along the street, I observe that the lamps are mostly quite dark in the centre, and that every other part is luminous; some, indeed, are luminous in the centre, but are circumscribed by a small dark circle, while the rest is luminous; a spark from the fire, or a luminous star has the same appearance.—Query, What can be the cause?

2. I have been, of late, accustomed to the use of spectacles, but I find, that if I look at a book, with a good light, through the teeth of my pocket comb, I can read without them.—Query, How is this accounted for?

J. Y.

FIRST REPORT OF THE COMMITTEE

OF THE

GLASGOW MECHANICS' INSTITUTION,

FOR THE

Promotion of the Arts and Sciences.

In Reporting the proceedings of the Committee since their first appointment, in July last, it will be unnecessary to go minutely into a detail of the whole matters which have passed under their management, because they have, during their period of office, frequently had the pleasure of meeting with their constituents, and of submitting to them several reports, and receiving their instructions on various matters;—nevertheless, for the sake of connection, a mere sketch of their diversified proceedings will now be submitted to this, the First General Meeting of the Institution, held under the Constitution.

The Committee shall gladly pass over, without remark, the train of circumstances which led to the formation of this Institution. They take this course, not that they feel at all afraid to meet any one, regarding these disagreeable matters, but they consider that their attention is required to far more important subjects. Whatever may have been the *causes*, the *effects* at least, it will be admitted, have been truly important. Science should know no party, and while your Committee have found, and new Committees will still find, sufficient labour in superintending the interests of their own Institution, they may still heartily wish success to all Institutions of a similar design, and acknowledge as brethren those who, imbued with a kindred spirit, may incline to drink knowledge from other fountains.

Your Committee was appointed on 5th July last; and when they consider how much they have since been enabled to accomplish in a period of less than ten months, they feel their *reward* in their *success*, and in the commanding station, in this respect, which they have been the humble instruments of causing this city to assume. Your Committee, shortly after their appointment, drew up and circulated an Address, explanatory of the steps which their Constituents had taken, *which*, they are glad to learn, has been *acknowledged* as no less distinguished for its accuracy in fact, than for its moderation in spirit.

The most important, and the most difficult of the subjects to which your Committee were called to direct their attention, was the obtaining a suitable Hall for the Lectures. A detail of the difficulties they had to surmount, in this matter, they submitted to the General Meeting held in Union-Street Chapel, on 20th Sept. last. Agreeably to the instructions then given, the Committee concluded a lease of their present Hall, on what were conceived moderate terms. The lease exists for seven years from the present term of Whitsunday. The landlords liberally granted it for the time already possessed, free of rent, and for future years at the rent of £42. The landlords sustain the roof; but the Institution was at the expense of the alterations, which cost about £130. They are glad to think that the fitting up of the Hall, on which the Committee bestowed much of personal attention, has met with the approbation of the members, and that it is publicly acknowledged to be the most extensive and commodious Lecture-room in the city.

With respect to the Library, the Committee have to report, that there is at present upwards of 1300 volumes in the catalogue. The Committee expended upwards of £160 in the purchase of Books, and in so doing they made a most scrupulous selection of such only as had a most decidedly useful tendency, and they made their purchases upon estimate, and on a plan of the strictest economy. To those who came forward, so liberally, with donations of Books, the Committee and the Institution owe their thanks. A Library of such an extent, completed in about two months from its commencement, is a circumstance unexampled in similar Institutions. Your Committee still hope, that, in the course of the summer, many more donations will be made. The Committee owe it, as a mark of respect to their much respected Secretary, to mention, that without his con-

labours, carried on with a spirit, h they regret to say he has even ed his health, the Library could e been opened for a much longer It is also proper to mention, that ameron kindly printed the cata- without making any charge, ex- r outlay.

Committee, agreeably to the re- s passed at the Meeting in Union- Chapel, on 20th Sept. last, engaged eel as Lecturer on Mechanics and stry, in terms of his letter; viz. should lecture twice, and if ne- , four times a-week, and produce essary illustrations, on receiving n each ticket, to the extent of which would amount to £150, what sum should be less than that t in the event of not so many being sold, and leaving it to the to say what proportion, if any, be allowed above that sum should ickets be sold. The Committee ccordingly, paid him the stipulated £150; but as nearly 1000 tickets een sold, they have unanimously to recommend to the members to additional sum of £50 as a , without any reference, however, re engagements.

Steel has now completed his and it remains with the mem- say how they are satisfied with anagement of that course, and r or not Mr. Steel shall be con- their Lecturer. The Committee willing to interfere with the right ently vested with the members, the expression of an opinion in tter. The members, whose at- has not been distracted from the s of the course, are the better on this subject, and the Commit- only hope, that now and in future ht will be always exercised with- sonal feeling, or party views, but single eye to the promotion of the terests of the Institution, and it, the advancement of science s, and the dissemination of useful dge.

ough the Hall is very large, yet found insufficient for the numbers pplied for tickets; and many ex- the difficulty of attending on nings of Saturday, Mr. Steel, ly to the conditions in his letter agement, commenced a second *on separate evenings*, and a *of tickets was permitted* from the one course to the other. The num- ber attending the first half-course ap- pear to have been 946.—In the second half-course, a considerable number failed to renew their tickets, but nearly as many new tickets were purchased, which made the number to stand in the last course about 940.

Mr. M'Fadyen gave a very interesting course on Natural History, and at the conclusion he was unanimously re-elected by his Class, agreeably to the powers conferred on them by the Constitution, and, in addition, presented with a hand- some present by his pupils. Mr. M'- Fadyen has kindly given the whole pro- ceeds of his course to the funds of the Institution. The amount of the tickets sold were £50 5s. The expense of paintings illustrative of the course, ad- vertising, &c. as per vouchers, are £28 3s. 9d. Leaving a balance of £22 2s. 3d., which is carried to the funds of the Institution. Mr. Mackie has been elected Lecturer on and Teacher of Mathematics, and he intends com- mencing his course of instructions in this important branch of Science, on the first Monday after the Glasgow Fair, in July. Dr. Brown, who has already given one Lecture to the mem- bers, will commence his course on Popular Anatomy in August. Offers have also been made for Lectures on Political Economy, English Gram- mar and Composition, and Botany; but these offers the Committee have thought it prudent to decline, at the same time tendering the Gentlemen their thanks for their kindness.

Several gentlemen, friends of the In- stitution, having been pleased to send donations of Minerals and Natural Cu- riosities to the Institution, your Com- mittee received them, and commenced the formation of a Museum, which has received considerable accession, and may, perhaps, be yet encreased by the kind- ness of friends. The Committee are anxious to procure for the Institution a Set of Complex Machinery and Ap- paratus, for the illustration of the Lectures. Towards obtaining this de- sirable object, Mr. M'Fadyen kindly gave a Lecture, which has yielded £15 2s.; and Mr. Steel has also added three Lectures for the same purpose, which have produced £14 8s. 6d. Your Committee hope, during the summer, to do something considerable in this matter, and rely on the assistance of

the practical Mechanic, who may thus, perhaps, do a benefit to himself and good to the Institution, with which his name and character is so much identified. The Committee early turned their attention to the framing of the Constitution, and the Rules, and Regulations; and anxious that these might be as perfect as possible, they bestowed much attention on them, and having been submitted to the members at two General Meetings, on 19th and 25th Feb. last, and then approved of, they have since been confirmed by the Magistrates, who have passed a Charter of Erection and Seal of Cause, incorporating the members.

It now merely remains to allude to the state of the funds. Agreeably to the Regulations, a Committee will be now elected to examine and docquet the Treasurer's Account and report to next Meeting. In the meantime, the Committee will submit to the Meeting an Abstract of their Accounts. It will be seen, from that document, that there is a balance due the Treasurer of £65 18s. 5d.; and should the members agree to the further grant of £50 to Mr. Steel, the debt due to the Treasurer will be encreased to £115 18s. 5d. But, opposed to this, the Institution can show, at least, £280 of property, and they can look forward to funds arising from the classes of Mr. Mackie and Dr. Brown, and, especially, to the course on Chemistry and Mechanics, next winter for the total extinction of this debt, which, considering what has been accomplished, is small indeed.

In conclusion, the Committee have now brought their arduous labours to a close, and they take farewell of their constituents with every wish for their welfare as individuals, and as connected with this Institution. They owe their warmest thanks for the support they have received from them, and them alone. It is gratifying, indeed, to think that all this has been done without the slightest aid asked, or obtained, from the public. Those who have been connected with the formation of this Popular Institution, may well feel proud, not merely when they view the mental enjoyment they have procured for themselves and their children; but the proud lead which they have enabled this city to take in the march of scientific improvement—a pattern which has been well imitated by almost every considerable manufacturing town in the United Kingdom, and to which the Committee have afforded every assistance in the way of information and advice. Let us trust, therefore, that our future career may correspond with the splendour of our dawn, and that no improper spirit may ever destroy our calm pursuits after knowledge; but that, in future generations, the Glasgow Mechanics' Institution may remain, at once, the "Parent and the pattern of all similar Institutions over the world."

15th May, 1824.

NOTICES TO CORRESPONDENTS.

We are much pleased with the remarks of Y. and wish that he would transmit such articles as he recommends.—C. S. should answer his own query.—J. T. is very polite, but we *strongly suspect* he is a quiz; his query wont do.—We were informed by our publisher, that J. W. the inventor of the improvement on the Rotatory Steam Engine, was a very modest young man, who did not wish us to make any remarks on his communication if it did not please us. His last letter on the subject, however, has undeceived us; his improvement will be inserted; but, in the meantime, let him exercise the duty of patience, as we cannot do every thing at once.—Some of the observations by G. B., Hamilton, and D. C. M., Johnstone, will be inserted. If R. H., Musselburgh, could improve the solution of his problem, which is correct, by referring only to one figure, instead of two, it will be inserted.—G. F.'s communication is neither "too long," nor "too trifling," but it contains nothing new, as the rules he has given are to be found in every work on the subject; another objection is, that he has not arrived at any *practical result*, as he has *not solved* a single equation that he has proposed, notwithstanding his numerous steps towards a solution; the third step of his first equation is likewise erroneous, and consequently all that follow are so.—J. S. L., A. W., Rothesay, and Rusticus, will be inserted.—We are much obliged to A. B., Dollar, whose communications will be inserted soon.—J. D. C. has been received.—J. F.'s solution to the "point of meeting query," is deficient, as it merely gives the number of revolutions before meeting at the same point where the travellers set out; but it is evident that they must meet many times before this occurs, and it is the first time and point of meeting that is wanted.

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THE GLASGOW

MECHANICS' MAGAZINE.

> " What cannot Art and Industry perform,
> When Science plans the progress of their toil!
> They smile at penury, disease, and storm;
> And oceans from their mighty mounds recoil."—*Beattie.*

No. XXII. *Saturday, 29th May,* 1824. Price 3*d.*

SUSPENSION BRIDGE ACROSS THE KELVIN, NEAR GLASGOW.

Fig. 1.

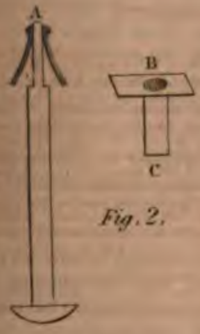

Fig. 2.

Fig. 3.

ON SUSPENSION BRIDGES,

With a Description of ONE recently erected across the River KELVIN, near GLASGOW,
(Called KING'S BRIDGE,)
Under the Superintendence of Mr. HERBERTSON.

THE wonderful skill and ingenuity of man has in no instance been more successfully displayed than in the erection of suspension bridges. From the rude mode of passing from bank to bank on trees thrown across the narrowest streams, to the magnificent and stately buildings of stone which have been carried over the most extensive and rapid rivers, and which alike defy the effects of the storm and the ravages of time, the transition is both interesting and sublime. The Romans, who are seldom allowed by historians to have any merit in the arts or sciences, and who were mere imitators of the Greeks in these respects, are supposed to have been the inventors of the architecture of bridges. The splendid examples they have left in many places, but particularly in Spain, show that they have not only been masters of the art of building in general, but of every structure that depended on the erection of arches. Though they have been out-done by the moderns in the art of erecting bridges, yet even the noble instances of architecture that have been exhibited in this department, are far excelled by those wonderful specimens of scientific skill which have recently created a new era in the history of bridge-building.

That beams, or arches, laid upon piers and supported from below by resting on the earth, would enable man to cross a river otherwise impassable, except by means of floating vessels, was sufficiently obvious from the nature of their structure; *but that he should* be enabled to *pass by suspending* the supporting *material above* the water, was a much bolder idea, and one which, though it might occur, was evidently far from being so practicable as the former. Attempts, however, have been made in various ways to accomplish this idea, and they have been in many instances eminently successful. The common mode of crossing ravines and rivers, in the interior of America and India, is by means of ropes, of various kinds, which are stretched from side to side, having sometimes a road-way upon them, forming a complete rope-bridge, and in other cases merely a basket suspended from them, which is drawn across whenever the traveller is seated in his aerial car.

Iron chains, rods, and wires, however, have been most successfully employed for the same purpose, and they have been applied in various ways, so as to render the art of erecting chain bridges and piers an interesting branch of study for the civil engineer, and one that is likely to supersede the more expensive and difficult mode of constructing bridges of cast iron. Chain bridges, of very great extent, are said to have been long in use in China, and Major Rennel describes one of 600 feet in length, which is thrown across the Sampoo of Hindostan. The first chain bridge erected in this island, was Winch Bridge, which was thrown across the river Tees, in 1741, over a chasm nearly 60 feet deep, for the passage of travellers, but particularly of miners; it is 70 feet in length, and about two feet broad, with a hand-rail on one side, and planked in such a manner, that the traveller experiences all the tremulous motion of

the chain, and sees himself suspended over a roaring gulph, on an agitated and restless gangway, to which few strangers dare trust themselves.

Bridges on this plan were subsequently erected in the United States of America; and there is one (erected in 1809,) over the river Merrimack, in Massachusets, of 244 feet span, having two carriage ways, each 15 feet in breadth, and capable of supporting 500 tons. The following suspension bridges have been recently erected in Scotland:

	Date.	*Span.*	*Breadth.*	*Cost.*
Galashiels Wire bridge, ...	1816	111 feet	———	£40
King's Meadows do...........	1817	110 do.	4 feet,	£160
Thirlestane do...........	——	125 do.	———	
Dryburgh Chain do...........	1818	260 do.	4 do.	£720
Berwick Union do...........	1820	361 do.	18 do.	£6050

The suspension bridge across the river Kelvin, exhibited in the plate, was erected in the year 1822, by James Gibson, of Hillhead, Esq., for the purpose of connecting the lands of Hillhead and Blythswood. The foundation stone of this bridge was laid with Masonic honours, at the time when his Majesty was in Edinburgh, and, in commemoration of the Royal visit to Scotland, it was named King's Bridge. It was designed and executed under the superintendence of John Herbertson, Jun., Architect, on the principle of suspension bridges, with the chains or rods below, and the weight resting on the rods by means of cast iron brackets, on which the beams are placed.

The bridge is 63 feet in span, and twelve feet wide, and there are five beams of crown memal in the width, each being twelve inches deep, by six inches thick, in two lengths. The rods, which are made of Ackerman's chain iron, are one and one-fourth inches in diameter. They are bent round the ends of the beam, and fastened with a hoop of iron, two inches broad, by one inch thick, to prevent it from springing, as is shown in the plate, fig. 1. Buckling screws are placed on each rod, near to the brackets, for the purpose of tightening the rods and raising the beams to the level, so that the whole structure can be adjusted with the greatest ease.

That this plan may be carried to any extent, is evident from its simplicity and capability of sustaining an enormous pressure. From the construction, it will be easily seen, that the whole weight or pressure is exerted on the iron rods, or wires, in the direction of their length, so that they have no tendency to break or bend in a lateral direction. The amazing strength that this mode of connecting the ends of a wooden beam imparts to it, may be illustrated by a very simple experiment. Let the mechanic take a piece of wood, about two or three feet long, and an inch in diameter, place the ends of it between two chairs, or stones, and attempt to stand upon it, and he will find it break almost instantaneously. Let him now take a similar piece of wood, and bend round the two ends a piece of wire so much longer than the wood as to allow a small wedge, or wooden pin, two or three inches long, to be placed vertically between the wood and the wire, and he will find that he will be unable to break it, though he leap upon it with all his force. The application of this principle may be seen in all cases where brackets and trussed beams are employed, though it has been seldom perhaps carried to any

great extent, and never, we think, to that of which it is capable. The construction of a bridge of a very great span, such as that over the Menai, would afford a fine opportunity for the experiment, and there would be little doubt of its success from the extreme tenacity of which iron wire and malleable iron rods have been recently demonstrated to be susceptible.

H.

IMPROVED SHOP-WINDOW BOLT.

Fig. 2, is a representation of a bolt for securing shop window-shutters, the superiority of which, over the one in common use, has been long experienced by the inventor. As such a contrivance is a desideratum among shopkeepers, the insertion of it in your Magazine may be useful to them.

The iron tube B C, is fixed in the casement of the window, the end B innermost.

At the end A of the bolt, are fixed two steel springs, which allow it to be thrust in easily, but prevent it from being withdrawn. When the bolt is to be taken out, the springs are pressed together and introduced into the tube. C, the end of the tube, should project a little beyond the casement, that the springs may not catch the shutter as they are coming out.—Your's,

Glasgow, 26th April, 1824. M. W.

CHEMICAL EXPERIMENTS.

On Oxygen Gas.

Oxygen Gas was discovered by Dr. Priestley, in 1774, and was at first denominated *dephlogisticated air*. It was afterwards called *empyreal, and vital, air*, till it received its present name from Lavoisier. It is destitute of colour, taste, and smell, and it is invisible, expansible, and compressible. Being heavier than common air, its specific gravity is 1.1111, that of the former being unity.

It is a powerful supporter of combustion. If a lighted taper be introduced into a phial filled with this gas, it will burn with such splendour that the eye can scarcely bear the glare of the light, and will, at the same time, produce a much greater heat than when burning in common air. If the taper be extinguished, and immediately introduced into a similar vessel, it will instantaneously re-kindle, slightly explode, and continue to burn with a rapidity, a brilliancy, and a strength of heat, truly wonderful.

Oxygen gas is also an essential supporter of respiration. Animals can live in a given quantity of this gas much longer than they can do in an equal quantity of common air. A bird which lived only three hours in a vessel filled with common air, lived five hours and 23 minutes in it when filled with oxygen gas. Indeed, no animal can live in any kind of air, or gas, which does not contain a portion of this gas. Common atmospherical air contains 21 parts of oxygen gas in every 100 parts of its bulk.

This gas combines with other bodies, and forms different gases. If a wire, having a piece of charcoal, just extinguished, fixed on the end of it, be introduced into a large phial containing oxygen gas, the charcoal will instantly begin to burn with a very vivid light, and throw out a number of brilliant sparks, which, if thrown with a violent jerk against the side of the phial, will either melt their way through, or lodge in the substance of the

glass. The gas thus produced by the combustion of the charcoal, forms a new gas called carbonic acid gas.

Oxygen gas may be procured in the following way: Put a quantity of the black oxide of manganese, which is easily procured, as it is found in a native state, into an iron retort, and surround it with burning coals till it be red-hot. Place the extremity of the retort, which must be tubulated, about an inch below the surface of a vessel filled with water. When the retort is heated, it will by degrees expel the greater part of the common air contained in it; when it becomes nearly red-hot, the gas bubbles will begin to appear in great quantities at the extremity of the tube, and they will increase with the heat. It is then time to collect the oxygen gas, by placing a glass vessel, filled with water, with its mouth downward, and immediately over the end of the tube. The gas will then ascend, in bubbles, to the top of this vessel, and gradually displace the water. When the water has disappeared, and the vessel is full of gas, it may be removed, by placing below it a shallow vessel capable of holding a small quantity of the water, to prevent the gas from escaping; when this is done, it may be taken away, and another filled in the same manner, till the retort ceases to emit the gas.

This gas may also be obtained by pouring over the black oxide of manganese as much sulphuric acid, or oil of vitriol, as will make it into a thin paste. In this way it may be made more easily by putting it into a glass retort, which is heated by means of a candle or a lamp. The tubulated end of the retort is to be placed under the water, and the gas may then be collected in the same manner as before. This is most easily done, with the assistance of the pneumatic trough, which is constructed for the purpose, and is so simple that it is understood as soon as it is seen. Oxygen gas may be also obtained in a very elegant manner by the decomposition of water, which is easily effected by the galvanic pile, or trough, a process that will be explained in my next.

H.

SOLUTION OF THE BOARD QUERY.

SIR,—The following is a solution of the second query proposed by Rusticus, at page 286.

Let A B C D be a rectangular board, right angled at A and at D. Its length, A D, 40 inches; its breadth at the one end, A B, 18 inches, and at the other, D C, 10 inches. It is required to cut out of the board, A B C D, a part, *a b c d*, whose length, *a d*, shall be nine inches, and its area equal to a square foot.

Geometrically.

Produce D A to *h*, making A *h* equal to *nine inches*. By the 45th of the 1st of Euclid, describe, upon the line A *h*, a right-angled parallelogram, A *i g h*, which shall be equal to a square foot. Produce *i g* till it meet B C in *e*. From *e*, let fall upon A D, the perpendicular *e f*; and from *f*, upon A D, set off the distances *f a*, *f d*, each equal to 4½ inches. Draw *a b*, *d c*, each parallel to *f e*, and cutting B C in *b* and *c*; the trapezium, *a b c d*, is the part required. The demonstration is evident.

By Calculation.

Draw C *l* parallel to D A, cutting A B in *l*. A *l* is equal to

$DC = 10$, $Bl = AB - Al = 18 - 10 = 8$. And because the sides, $a\,b$, $d\,c$, of the trapezium $a\,b\,c\,d$, (which is equal to a square foot,) are parallel to each other, its mean breadth $e\,f$, is equal to its area divided by its length;* or equal to $\frac{144}{9} = 16$. Again, $f\,k$ is equal to $DC = 10$, and $e\,k$ is equal to $e\,f - k\,f = 16 - 10 = 6$.

Hence, in the triangle $B\,C\,l$ are given the sides $C\,l = 40$, $l\,B = 8$, and $e\,k = 6$, which is parallel to $B\,l$; whence $C\,k = D\,f$ may be found: For $C\,k : C\,l :: e\,k : B\,l$; whence $C\,k$ is equal to $\frac{C\,l \times ek}{B\,l}$; that is, $C\,k$ is equal to $\frac{40 \times 6}{8} = 30$. Lastly, $D\,d$ is equal to $D\,f - f\,d = 30 - 4\frac{1}{2} = 25\frac{1}{2}$, and $D\,a$ is equal to $D\,f + f\,a = 30 + 4\frac{1}{2} = 34\frac{1}{2}$.

Thus it appears, that if the board A B C D be cut, at right angles to the side A D, at $25\frac{1}{2}$ inches, and at $34\frac{1}{2}$ inches from the end C D, the piece so cut out will be nine inches in length, and just a square foot; or, rather, equal to a square foot.

Your's, &c.

J. D. C.

Glasgow, 15th May, 1824.

* In any quadrilateral, that has two of its opposite sides parallel to each other; if each of the other two sides bisected, and the points of bisection joined by a straight line, and if from any point in any of the parallels, a straight line be drawn perpendicular to the other parallel (produced, if necessary,) the rectangle contained by these two lines, is equal to the quadrilateral.

We have received two other solutions from J. W., Paisley, and A. W., Rothesay, but as neither of them was so clearly explained as the above, it was preferred. The question, however, as originally stated, was not sufficiently clear, because a true rectangular board should have all its angles right angles, and its opposite sides equal. If, however, a board has two right angles, as our Correspondent has supposed, it may, by a latitude of language, be denominated rectangular.

RECENT PATENTS.

To Miles Turner *and* Lawrence Angell, *of Whitehaven, in the County of Cumberland, Soap Boilers, for their Invention of an Improved Process to be used in the Bleaching of Linen, Cotton, Yarn, or Cloth.*

This invention, is the mixing of a chemical compound to produce a bleaching liquor of a new kind. The materials are alkaline sulphuret, broken into small pieces and mixed with quick lime, in the proportion of about eight bushels of lime to fifteen or sixteen hundred weight of sulphuret. These substances are to be thrown into a *soap-maker's* vat, having a quantity of straw, cinders, gravel, or other porous material, placed at the bottom for the liquor to filter through, and then the vat filled with water. After standing a proper time, the water is to be drawn off, which will be found to be a bleaching liquor of superior quality.

A second vat, with a filtering material at bottom, may be placed above the first, and the sulphuret and lime which remains undissolved in the first vat, may be emptied into the second vat, and a fresh charge of water poured upon it. The lower vat is then to be recharged with sulphuret and lime,

and the water in the upper vat having remained a sufficient time, is to be filtered into the lower vat, and allowed to stand as before, when it is again drawn off, and is ready to be employed as a bleaching liquor. By repeating this process, all the valuable matter is extracted from the sulphuret and the lime, and what remains in the upper or weak vat, which has had two doses of water, will be only useful as soaper's waste.

The liquid being so produced, should be diluted with water till it shows, by the hydrometer, about the same density as the bleacher uses his leys of potash for the same purpose, and the yarn or cloth must be bucked or boiled in it. The bleacher may then proceed in the usual manner, by exposing the goods operated upon to the atmosphere, oxymuriatic steeps, sours, &c. by using this ley, in boiling and bucking, as a substitute for potash.

But a process of bleaching, which constitutes one of the features of this invention, is, to take the yarn or cloth immediately from boiling in the prepared ley, and to immerse it in any cheap acid, (as oil of vitriol,) after this, steeping and washing it in oxymuriatic acid of the ordinary density used by bleachers, and then boiling in the said ley, and steeping and washing, as before, several times over, without exposure to the atmosphere, until the fabric so operated upon has become perfectly white.

Sealed 24th July, 1823.—Inrolled September, 1823.

To Matthew Wilks, *of Dartford, Kent, Seed-crusher, for his Method of refining Oil produced from Seed.*

The method adopted by the patentee in purifying oil produced from linseed, or any other description of seeds is simple, and consists in the following process:—

Into two hundred and thirty-six gallons of linseed oil, or oil procured from any other seed, six pounds of oil of vitriol is to be poured and well mixed, by beating and stirring, for about three hours. Six pounds of Fuller's earth is then mixed up with fourteen pounds of hot lime, and these matters when properly incorporated together, are thrown into the vessel containing the oil and vitriol, when the whole is to be kept in complete agitation for about three hours.

The above mixture is now to be introduced into a boiler containing a quantity of water equal to that of the oil, and the whole boiled together for three hours, keeping it continually agitated during the boiling.

The fire is now to be withdrawn from the boiler and the materials within allowed to cool, after which the water is to be drawn off and the oil will be found clarified, which, after standing for some time, will be fit for use.

Sealed 20th December, 1822.—Inrolled June, 1823.

To John Francis, *of the City of Norwich, Shawl and Bombazeen Manufacturer, for Improvements in the Process of making or manufacturing a certain Article or Fabric, composed of Silk and Worsted, for useful Purposes.*

The article, or fabric alluded to in the above ambiguous title is crape, and the proposed improvements seem to be rather in the introduction of some novel feature in that article, than in an improved process of manufacture. The patentee proposes to make crape with satin stripes, or satin figures raised above the surface, and this is said to be done by "forming in the ground a Tammit work, with or

without a figure," or it may be done by a *twill*.

The crape is produced by a silk warp, interwoven with a worsted weft, and the satin stripe is formed by an additional silk warp wound upon a distinct roller, or beam, from that which carries the foundation warp. The mode of producing this satin stripe, or pattern, is not different from that usually resorted to in weaving twills, or figured goods; that is, the warp threads must be connected to the headles, and drawn according to the twill, or pattern, required. There is no description of the particular mode of working the loom given in the specification, and it appears to be presumed by the patentee, that the method of effecting the object, is sufficiently obvious from the above explanation.

Sealed 12th April, 1823.—Inrolled June, 1823.

London Journal of Arts, &c.

INTERESTING EXPERIMENTS ON SOUND.

SIR,—As the query of your Correspondent Y., p. 293, has not been satisfactorily answered by G. M., in your last Number, I beg leave to offer you the following remarks, being part of some observations I had the honour of reading before the Glasgow Philosophical Society.

It has been frequently observed, that sounds are much louder through the night, and are heard, distinctly, to a much greater distance than during the day. This phenomenon has been ascribed to various causes. It has been thought that the loudness and distinctness of sounds at midnight, is in consequence of the greater acuteness of the organ of hearing, at a time when the mind is less distracted by other objects.

It is no doubt true, that when the mind is intensely directed to the communication of one of the senses, abstracting itself from the information of all the others, that the organ of that sense becomes, for the time, and in some cases permanently, more acute. But the fact, that sounds are conveyed to a much greater distance through the night, and that there are sounds which in the bustle of the day we cannot hear distinctly, whatever attention we may pay to them, shows, that there is something else necessary to account for the phenomenon than the greater or less acuteness of the organ of hearing. Another opinion is, that during the day, the air is traversed in all directions by a number of minute, and singly undistinguishable sounds or pulsations, which, by disturbing the air, render it a much worse conductor of sound in the day-time, than during the night.

A very remarkable instance of this occurred in the course of some experiments made by M M. Biot and Martin, in the neighbourhood of Paris. They found that, during the silent hours of night, they could converse through a tube 1040 yards in length, with as much ease, as if they had been in the same chamber only a few feet distant from each other; while in the day, they could with difficulty hear each other through a tube only 4 or 5 hundred yards. This remarkable difference was evidently owing to the disturbed state of the air within the tube, arising from the number of vibrations of the various sounds passing through the atmosphere in every direction.

In the 3d volume of the Edinburgh Philosophical Journal, the difference of the conducting power of the air during the night and the day,

is ascribed to the influence of the sun rarifying the air in particular spots, and by thus rendering the whole unequally dense, causing an undulation in the pulsations of sound which would dissipate and retard their motion. That light and heat have a considerable influence on the conducting power of the air, there can be no doubt. The remarkable phenomenon related by Captain Parry, of the great distance at which the ship's crew could hear each other in the frozen regions, is a proof, that either the density of the air, or the absence of light and heat, is favourable to the transmission of sound. But, the effects thus said to be produced by the sun, can hardly be ascribed as the cause of the very great difference in the transmitting power of the tubes described by M. Biot; while, at the same time, there are a number of experiments to show the existence of these minute sounds or pulsations during the day; and that they affect the transmission of particular sounds, may also be shown by experiment.

The existence of these pulsations, the last expiring vibrations of many sounds, may be inferred from the great contrast between the deathlike silence of the night, and the peculiar hum and bustle of the day, which every person of ordinary observation must have frequently remarked. And the phenomenon of the sound of a shell, or other hollow vessel, applied to the ear, exhibits some of the effects of these pulsations. During, the day a continued and unremitting sound is heard from the shell, but in the silent hours of midnight there is not a whisper to be heard. Even in the day, at a distance from the sea shore, and from the bustle of large towns, when the evening and the morning labours of the ever busy mechanic keeps up the never ending sound, we will find intervals of repose, when we might in vain apply the shell to relieve us from the dreary silence that reigns around.

That these minute sounds, or pulsations, are the cause of the sound in the shell, from the above remark, I think there can be little doubt. With regard to how, or in what manner they excite the sound, is another question, which may not perhaps be so easily answered. My opinion however is, that the air contained within the shell or hollow vessel, is thrown into a sounding state, by the impinging of these pulsations, and this opinion appears probable from the following circumstances.

The quality of the sound from a hollow vessel is always the same, whatever may be the nature of the external sound producing it. The relative acuteness or graveness is affected by the size of the vessel, or by opening or shutting the aperture. This may be very easily ascertained by any person in this manner. Let him hold his two hands over his ear, and if there is any external sound, the air within his hands will give the same sound as the shell; and if he alternately open and shut his hand, he will find the sound varied by an interval of nearly an octave.—Your's, &c.

Glasgow, 25th May, 1824. A. B.

COMPARATIVE MERITS OF COAL AND OIL GAS.

A good deal of discussion has of late arisen regarding the comparative merits of these two gases, and so much has the subject been perplexed by the conflicting statements of rival manufacturers and companies, that the question can hardly yet be considered as settled, although the general impression undoubtedly is, that

the coal gas, where coal is abundant, has the advantage in point of economy, though it is rather inferior to the oil in point of purity. As the subject has become interesting to the public, we shall state a few facts regarding it, which are perhaps not generally known, and for which we are partly indebted to an interesting report lately published by the Dundee Gas Company, and which forms the result of certain inquiries set on foot by that Company for their information. First, then, in regard to the expense of manufacturing coal gas, this, as may be expected, will vary with the price and quality of the coal, and also with the skill and economy in managing the different processes of the manufacture. In Glasgow, the cost of manufacturing 1000 cubic feet of coal gas is so low as 4s. 9d. exclusive of interest on capital. In Edinburgh it is from 7s. to 8s. In Liverpool and London about 10s. But the selling price of the gas in these different places is exactly in proportion to the price of producing it. In Glasgow, 1000 feet of gas sells at 8s. 6d., in Edinburgh at 12s., in Liverpool at 13s. 9d., and in London at 14s. 6d. or 15s. The difference arises partly from differences in the dividends paid by the Companies on their respective capitals, and partly, also, we believe, from waste, and perhaps part of the current expenses not being included in the cost price.

But even the quality of the gas in different establishments varies considerably in its illuminating power, owing partly to management, but chiefly to the nature of the coal from which it is generated. In this respect the gas from cannel coal, from which most of it is got in Scotland, is decidedly superior to the London gas, which is all produced from Newcastle coal; a cubic foot of the former will burn from one to one and a half times longer than one of the latter, and give all the time the same degree of light. On this account, therefore, the fair illuminating value of the gas in the above places does not correspond with its selling price, the London gas being really from one to one and a half times dearer. This consideration is of essential importance in all our inquiries into the economy of gases, and a want of due attention to it is one of the chief causes of those discrepant results which have been obtained on this subject, and of that diversity of opinion to which they have given rise.

In regard now to the price of manufacturing and selling oil gas, this is pretty much the same in different places, and the gas being all generated from the same material, its quality is hence pretty uniform. The cost of manufacturing 1000 cubic feet of oil gas is estimated by Taylor and Martineau, the patentees, at 26s.; by Mr. Peckstone at 28s.; by Mr. Ricardo, of the Bow Works, at 27s.; and it is actually made at Hull for 28s.; and at Leith, we believe, much the same. The selling price again is in London 50s.; in Hull 50s.; in Leith 50s., until of late it has been reduced to 40s., the lowest price at which it has ever been sold. But there is one important circumstance to be noticed here. At the above prices of the coal gas, all the Companies have been dividing considerable profits, which may be averaged at 8 per cent. on the capital of each, while the Oil Gas Companies again, at their prices, have been in many cases losing, and in no case dividing more than 2½ or 3 per cent.* It thus appears, then, that the same quantity of gas which, in the case of coal, sells in Glasgow at 8s. 6d., in Edinburgh at 12s., and in London at 14s. 6d., cannot, in the case of oil, be any where sold with a profit under, we may safely say, 45s., supposing even the oil to continue at the same rate to which it has fallen of late years.

But the quality of the oil gas is much superior to that even of the best coal in its light-giving power. A cubic foot of it will burn with an equal degree of light between three and four times longer than the London gas, and between two and three times longer than the Scotch gas.†

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* The Whitechapel Road Oil Gas Company, according to Mr. Tait's information in the Dundee Report, divided, at the end of the first year, 2½ per cent.; but at last general meeting (November, 1823) no dividend was made. The Hull Company, by the same report, has paid nothing; the Norwich nothing, and the Colchester has been converted into a coal gas.

† Although the exact proportion of the illuminating powers of these gases has not yet been settled, a good many experiments have been made with this view; these, when rightly considered, do not differ from each other so much as has been supposed, and agree, on the whole, pretty nearly in assigning the above ratio of between two and four to one in favour of oil, according to the quality of the coal gas. The sub-

If we take this circumstance into account, then, we shall obtain an exact estimate of the comparative economy of the two gases; 1000 feet of oil gas will thus give the same quantity of light as 3500 feet of London gas, and as 2500 feet of Scotch gas; and the prices of the same quantity of light derived from these different gases respectively will be, from oil gas, 45s., London coal gas, 50s. 9d., Edinburgh coal gas, 30s., Glasgow coal gas, 21s. 3d. The expense of the same light for tallow candles, at 1s. per pound, is about 80s. Of all these places, then, London is the most likely for an oil gas work to succeed as a profitable concern, Edinburgh next, and Glasgow the least. It appears evident, however, from these facts, that even in Edinburgh we cannot expect to obtain our light from oil gas at a price less than 50 per cent. higher than from coal, even though the price of oil should continue as it is. Considering indeed the waste which takes place in converting oil into gas, together with the expense of the process, it cannot be expected that the latter should ever form a very cheap light. In the present state of the manufacture a quantity of the inflammable matter of the oil is lost by the imperfect nature of the decomposition, besides a quantity of the gas itself, which

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ject has not certainly been examined with sufficient attention, nor with any thing like that degree of accuracy which such experiments demand, and in the present state of science, easily admit of, and we are surprised that some of the parties interested have not already set on foot such inquiries as will set this matter completely at rest. Professor Leslie, we understand, has been recently engaged in making some experiments on these gases; and certainly no instrument is so well adapted for comparing their illuminating powers as the photometer, with which he has contrived to measure the various shades of light. Under the hands of skilful observers, this instrument could not fail to lead to interesting results. The method of shadows, however, though not so satisfactory, nor in many respects so convenient, because we cannot easily compare, in this manner, the gases of different places unless they are actually brought together, and burned in the same apartment, whereas the photometer measures the actual as well as the relative degrees of light. Still, however, the method of shadows, with attention, and in the same place, will give a pretty near approximation to the truth; and we shall just state the results obtained in this manner by different observers. In London, Messrs. Taylor and Martineau find the illuminating powers of their oil gas $3\frac{1}{2}$ times superior to that of the coal gas in the neighbourhood. This estimate has been confirmed by Mr. Brande, and several other observers, more particularly by Mr. Dewey of New York, in an experiment conducted with great fairness, each foot of the oil gas burning exactly three and a half times longer than a foot of the coal. Hence, it has been laid down at once as a general rule, that oil gas is three or four times superior to coal in illuminating powers; and this notion, sanctioned by the names of the observers and the accuracy of the experiments, and propagated with zeal by the oil gas advocates and companies, has had considerable weight with the public, the Committee of the Dundee Company, for example, having hence calculated on the illuminating powers as 3 to 1. But we believe it is undeniable, that the London gas obtained from Newcastle coal is considerably inferior to the Scotch gas obtained from the cannel coal and other Scotch coals. The exact proportion we do not know, but it is between 1 and $1\frac{1}{2}$ times inferior—say, then, that it is only $1\frac{1}{4}$ times, and this, in the case of the Scotch gas, will reduce the estimate of Taylor and Martineau, the oil gas patentees themselves, to the proportion of $2\frac{3}{4}$ to 1 in favour of oil; and this corresponds pretty nearly with the observations which have been actually made in this country. Mr. Crichton of Glasgow, late civil engineer there, makes the proportion 2 to 1 in favour of oil. Dr. Ure of Glasgow finds the same proportion; and Mr. Milne of this city, the agent for the oil gas patentees, according to a writer in the Dundee Report, makes it, in reference to the Glasgow gas, as 2, or, at most $2\frac{1}{2}$ to 1. Experiments, we believe, have also been made by the Company here on the Edinburgh gas, which is generated from different sorts of coal, and for gas of an average quality, the proportion has been found as $2\frac{1}{4}$ to 1. Besides these authorities, an interesting set of experiments have been made by Messrs. Heropath and Rootsey on the Bristol gas, and their proportion is that of $2\frac{1}{4}$ to 1, or 2 to 1. Making due allowance, then, for the bias of the respective parties, we are certainly not under-rating the oil gas when we assume it, as above, at $2\frac{1}{2}$ times superior to our own coal gas.

is necessarily wasted in every gas establishment. Of the amount of these losses we are not informed, but a loss there certainly is to some extent.—Though there were no expense attending the manufacture at all, therefore, the light from the gas could not be so cheap as that from the oil itself, burned in a good lamp, where all the inflammable matter is consumed; and when we add to this all the expenses of the manufacture and gas establishment, it is evident it must be considerably increased, unless the oil acquires by its conversion into gas some new illuminating virtue which it does not possess in its raw state, a circumstance which has indeed been asserted but never proved. *

Such being the comparative economy of the two gases, let us now consider their respective qualities. On this point it is agreed on all hands that the oil is superior. In the first place, it is free from that sulphureous matter which rises along with the coal gas, from which it is difficult to deprive this latter gas, and the effect of which is not only to corrode the pipes, and all the internal fittings of the apparatus exposed to the gas, but also to tarnish the plate and gilding of the apartment in which the gas is burned. From this contamination the oil gas is entirely free, and this constitutes its great advantage. But, on the other hand, it cannot be denied that the plans which have been devised for purifying the coal gas have had considerable success. In Glasgow, and even in this city, where the coal is of inferior quality, the gas is now manufactured in such purity, that the presence of sulphur cannot be detected in it by the most delicate tests; and in fact it is said by these companies to be now incapable of tinging either plate or gilding any more than oil gas. † If this fact could be satisfactorily established, it would be of great importance. The best proof of it which could be given would be the adopting of the coal gas by jewellers, among whom its use was discontinued at the first trial, on account of its injurious effects, and has since, we believe, not been resumed by any of them. Another advantage ascribed to the oil gas is its freedom from any unpleasant smell. If this be meant of the gas itself as it escapes from the pipes by leakage or otherwise, the oil gas is in this respect certainly very little, if at all, superior to coal. We are convinced, indeed, from experience, that neither of them could well be tolerated, if allowed to escape unburnt; and it would be difficult to decide which of the two smells is the most offensive. But with proper attention on the part of the company, the escape of the gas can be entirely prevented, as is remarked by Mr. Tait, engineer, London, in his Report to the Dundee Company. "As to the smell of oil gas," says he, "being less offensive in rooms than coal gas, this is a mere matter of taste. For my own part, I would sooner tolerate the latter; but neither of them produce any smell whatever, if the services are secured, and the joints properly cemented." But if the smell refers to the effect on the air of the room by the burning of the gases, to the heat and closeness, to the smokiness, or to any other disagreeable vapour arising from any of the gases more than another—in this respect the

* Sir W. Congreve observes, that "there can be no doubt that the light thus produced by oil gas is much cheaper than that produced by the direct burning of the oil, and some have even estimated the gain at 25 per cent. It would require, however, strong proof to substantiate this fact, and the experiments of Heropath and Rootsey of Bristol show, on the contrary, a loss of 28 per cent.

† Mr. Neilson, engineer, Glasgow, in *his judicious* Report to the Dundee Company, *observes*, "the gas at present made in the Glasgow works seems to be entirely free of it, (the sulphuretted hydrogen,) and will not tinge either silver or gilding, nor can the acetate of lead, which is reckoned a delicate test, discover in it any of this offensive mixture." Besides the sulphuretted hydrogen, however, the gas contains hydro-sulphuret of ammonia, which proves injurious to copper and iron gas-pipes, and of which it is still more difficult to deprive the gas. Mr. Dewey of New York states, that this has been done by Mr. James Neilson of the Glasgow gas works, but that "owing to the expense of the process, and the low price at which the gas is furnished to the consumers, it has not been carried fully into effect." Great improvements, therefore, may yet be looked for in the purification of coal gas, the manufacture of which presents a rich and interesting field for the researches of the chemist.

oil certainly has the advantage. Much depends on the way in which the burners are managed, a proper attention to which will, perhaps, in either case, prevent any unpleasant effects. But on this point we have no satisfactory information.

"Oil gas," say Taylor and Martineau, "burns with a far purer and more brilliant light than coal gas." With good coal gas we cannot say that we have ever perceived a very material difference in this respect. Besides these, there are various minor points of comparison between the two gases, on which however, it is unnecessary to enlarge; and in regard to the advantage which oil gas possesses, of being more easily generated, and without any of those nuisances to which the coal gas establishments are subject, also its being less bulky, and held therefore in gasometers, and distributed in pipes of half the usual dimensions, these advantages are all involved in the price.

Such, then, are a few of the facts regarding these two species of light, which we have endeavoured to collect, from different sources, for the information of our readers. It is evident, on the whole, that the oil gas, though it will be a much cheaper light than candles, will yet here be considerably dearer than coal gas; but then it is purer, and burns with a brighter light; and, as Mr. Dewey of New York remarks, if some are content with *fine*, there is no reason why others should not prefer *superfine*. This, of course, is a matter of choice with the public; and it is not our intention, by the above remarks, to recommend either the one or the other light in preference, but merely to state the facts which have come to our knowledge.—*Cal. Mercury.*

DESCRIPTION OF THE ROCKING STONE, IN NOVA SCOTIA.

(*From the Acadian Recorder.*)

I AM fully convinced that Nova Scotia would be found possessed of as great a proportion of natural curiosities as any part of the continent of America, were it adequately explored; but few even of what have been discovered, have we on record; and even to our inhabitants, I have no doubt but that "the half has not been told." It is no less true than singular, that we often receive the first information of such curiosities as *have been* discovered in this province, from strangers—or in other countries. It was at all events the case with myself, in relation to the "Rocking Stone;" whose existence I first heard of from a gentleman in the United States, who had inspected it with much admiration and astonishment.

A few days since, accompanied by a friend, I resolved to be personally satisfied of the existence and bulk of this "wonder of nature." We rode to Spryfield (the distance to which is probably six miles) and there left our gig.—Following a foot-path which led past the side of a small lake, we struck into the woods, and after walking about three quarters of a mile, and pursuing the directions we had received, we came to *the spot. Its most interesting appearance is at first perceiving it.*

It stands upon a flat stone, the surface of which is level with the ground. The rocking is effected by the aid of a short lever, and may be set in motion by a child of twelve years of age. Although it is very difficult to attain the summit, yet we succeeded, and felt very sensibly the rocking as we walked to and fro upon it. We examined it very minutely, and discovered this vast body to move upon a pivot in the centre, of about 12 inches by 6, and a slight rest at the north end. The quality of the rock is granite, but apparently somewhat porous. After rocking and inspecting this wonderful stone for some time, we proceeded to measure its size, which we found to be as follows:—20 feet in length—14 feet in breadth—9 feet thick, and the circumference 74 feet. Its motion is from E. N. E. to W. S. W. The place where the rock is situated is rather pleasant, being a plain, with the ground undulary; and from its summit is presented to your view a beautiful lake, stretching serpentinely through the bushes. It is worthy of remark, that comparatively few stones appear in the neighbourhood of the rocking stone, and these quite small; so that no one can suppose it could by any accident have become disengaged from any large body of rock. It

is truly astonishing, and clearly evidences the skill and power of an Almighty hand! I broke off a piece for the purpose of ascertaining its weight, by which to form some idea of the number of tons contained in this rock.—The following is a crude statement of the result:—Its length being $3\frac{1}{4}$ inches—its breadth $2\frac{1}{4}$ inches—its thickness $2\frac{1}{2}$ inches, made 18 solid inches—and it weighed $1\frac{1}{2}$ lbs. The rocking stone, containing 2520 solid feet, makes its weight to be 162 tons. L. S.

Halifax, August, 1823.

VARIOUS COMMUNICATIONS.

ON THE LONDON STREET.

SIR,—In passing the Cross yesterday, I began out of mere curiosity to examine the progress of the building at the commencement of the new Street, and was very much surprised to find that it did not correspond with a very elegant design given some time ago in your Magazine. Upon inquiry, I learned that that design had been abandoned, and a very different one adopted. I also learned that the design which had been adopted was to undergo some alteration, and that in the meantime, the building was proceeding very slowly. It is proposed that the corner of this Street, next the Cross, should be rounded off, but how much my informant could not say, as the affair had not been determined. Upon examining the present plan more minutely while on the spot, I saw plainly that a small rounding off would not obviate the difficulties and dangers which will inevitably present themselves whenever the new Road is opened. I beg, therefore, to call the attention of the public, and those concerned, to the following strong objections to this plan. Suppose that the London Mail comes flying along the new Road, and is about to enter the Trongate, the horses will have to make three turnings before they can fairly clear their way into the Trongate, and each successive turning will be commenced before the preceding one is completed, and that in such a narrow compass, as to endanger the lives of many of his Majesty's lieges, not only as coach passengers, but as humble pedestrians.

In coming out of the new Street into the Saltmarket, one turning must be made; but, there being no room for the horses to recover their rectilineal direction, on account of the short space between the opening of the new Street and the head of the Saltmarket, in going out of the latter into the Trongate, another turning must be made, before the former is completed. In going into the Trongate while this turning is taking place, and before it is completed, a new one must be commenced, in order to avoid the statue of King William, against which the coach would be inevitably dashed, as it stands full in the way when turning the head of the Saltmarket. How much these turnings thus running into one another, and necessarily causing the jaded animals to pursue a serpentine course after a long stage, will endanger the safety of persons on the top of the coach, as well as the unwary foot passenger, who may be crossing the street at the time, and may be totally ignorant of the way he ought to run to avoid the danger, must be obvious to every one without comment. But how will the "confusion become worse confounded," and the danger indefinitely increased, when a coach shall happen to meet the mail at the turnings, while furiously driving in an opposite direction? Or when several vehicles shall meet at the turning points, from the Saltmarket, the Trongate, the High-Street, the Gallowgate, and the new Street? I believe there are few who would keep their seat in any one of the vehicles so circumstanced, without feeling a very considerable degree of apprehension. To many it would be positively alarming, and I think there is little wonder. The New Street Company would have avoided all these difficulties and many more which might be pointed out, had they adopted the plan given in your Magazine. They would have had a beautiful crescent, where now they must have an ugly rounding off; and the crescent would have rendered only one turning necessary, and that in such an easy and gentle manner, that it would rather have been a relief to the horses than an exertion. How far it may be practicable to adopt it yet, ought to be considered, as there is not much above ground, and as it will be ab-

timately of very great importance to the community.

Z.

St. Vincent Street, May 25, 1824.

ON DRESSING GOODS.

SIR,—In Number XIX. of your valuable Mechanics' Magazine, I notice an improvement mentioned in dressing muslins, &c. by gas, and your Correspondent wishes to know whether there is a Patent for it or not. A Mr. Hall, of Nottingham, has obtained a Patent for dressing cloth with gas, and also a Mr. Burn, of Manchester, has taken out a Patent for an apparatus, by which he dresses all kinds of goods made of silk, cotton, woollen, or flax. I have seen both plans, and do assure N. P. they are very ingeniously contrived; yet of the two I think Mr. Burn's is better calculated for general use, being less expensive and more simple, as he can use hot iron or gas, as may be convenient; and it may be set up in any bleaching works, &c. while that of Mr. Hall's can only be employed to advantage by such as dress for hire, as it will require a large capital to begin with; neither do I think Mr. Hall's method is well calculated for goods generally, as those which I have seen appeared very thin after being dressed. I would not have troubled you with this, had not your Correspondent wished for information; and as I constantly read your publication, if I could add any thing to it, I shall, at all times, feel great pleasure.

I am, Sir,
Your most obedient servant,
A FRIEND TO IMPROVEMENTS.

Chester, May 19, 1824.

We are much obliged to our Chester friend for his good wishes and willingness to communicate. We trust he will soon take an opportunity to do so, as a willing mind is the great desideratum; we wish that some of our friends at home, who we know are very able, were imbued with the same spirit. On the subject of this letter, we have received very important information, which we shall communicate perhaps next week.

WINDMILLS.

SIR,—In Nicholson's Encyclopedia, under the word "Mills," the following *statement occurs*:—

"*The simplest mode of constructing* a Windmill, is with a spiral sail, passing round a centre pole, tapering towards the summit, and spreading to a great width at the base. This certainly has not very great powers, but acts with great uniformity, and requires no attendance, since it matters not from what quarter the wind blows."

He adds that such a mill is cheap and safe, even in exposed situations. If any of the Correspondents of your valuable Miscellany have seen or heard of a Windmill of this description, and will give any information as to its construction, it will oblige a friend to your Magazine.

Z. A.

15th May, 1824.

QUERIES.

SIR,—In looking over the first Numbers of your Magazine, I observe an article in Number IV. which had before escaped my notice. It is concerning a meeting of the Highland Society of Scotland, when Mr. Dalyell submitted the models of various articles to the inspection of the Society; amongst other things there were mentioned an improved Row Boat, transmitted by Sir David Milne, and a Snow Plough, by Mr. Allan, at Pennycuik.

Will you, Sir, or any of your Correspondents, be so kind as answer the following Queries concerning these two articles.

1. Is Sir David Milne the inventor of the improved Row Boat, as it is only mentioned that he transmitted it?

2. In what respect does the improved Row Boat differ from other boats, and to what particular use (if any) is it to be appropriated?

3. In what part, or parts, of the Snow Plough, does it differ from the common plough now in use? And

4. Is it wrought like another plough, *i. e.* drawn by horses or oxen? And in what respect has it the advantage over the common plough?

A general description of these two articles, particularly answers to the questions, will much oblige,

D. A. N.

We join in our Correspondent's request; and we think the inventors would be the most likely to furnish appropriate answers. If, therefore, this should meet their eye, or that of any of their acquaintance, perhaps they would be kind enough to furnish the information wanted.

MISCELLANIES.

Lanterns.—M. Lariviere, a Mechanic at Geneva, has conceived the idea of substituting for glass in lanterns, plates of polished iron, pierced with small holes, regularly placed, and very close to one another. These plates allow the light to pass through them extremely well, and are much superior to metallic wires, which are easily deranged. The same person is at work upon a machine by which he will be enabled to pierce with regularity and expedition a number of small holes, so as to perform in a minute the same labour which, according to the existing methods, it would require an hour to execute. This invention will be very serviceable in the construction of sieves and filtering vessels.—*Lit. Gaz.*

To discover if Bread is adulterated with Alum.—The bread must be soaked in water, and to the water in which it has been soaked, a little of any test for sulphuric acid must be added. (Solution of muriate of lime will do.) Upon which, if any alum be present, the liquid will be pervaded with milkiness; but if the bread be pure, the liquid will remain limpid.—*Rationale.* Sulphuric acid has a stronger affinity for lime than for the alumina and potass with which it forms alum; it, therefore, quits those bodies, to form sulphate of lime with the lime of the test—which produces the milkiness.—*Griffin's Chemical Recreations.*

To distinguish a solution of Epsom Salt from a solution of Oxalic Acid.—1. Taste the solution; Epsom salt is bitter; oxalic acid extremely sour.—2. Pour a little tincture of litmus into the solution; if Epsom salt be present, the blue colour will remain unchanged; if oxalic acid be present, the blue will be turned to red.—3. Tincture of cabbage, or any other vegetable infusion, or a slip of litmus test-paper, are all acted upon by the acid, (which changes their colours,) but not by the salt.—What a pity it is, that people should poison themselves by swallowing the acid instead of the salt, when the method of distinguishing them is so easy!—*Ib.*

Test for the purity of Magnesia.—The common magnesia of the shops (which is a carbonate) is frequently adulterated with chalk; this may be detected by adding a little diluted sulphuric acid, which, with magnesia, forms a very soluble salt, but with lime, a very insoluble one. Pure magnesia (called *calcined* magnesia, in the shops) dissolves in diluted sulphuric acid entirely, and without effervescence.—*Ib.*

Test for the Purity of Wine.—Put into a phial sixteen grains of sulphuret of lime, (prepared by exposing to a red heat, in a covered crucible, equal weights of powdered lime and sulphur) and twenty grains of super-tartrate of potass (cream of tartar.) Fill the phial with water, cork it well, and shake it occasionally, for the space of ten minutes. Separate the clear liquid by decantation, and preserve it in a well-stopped bottle for use. A portion of this liquor, fresh prepared, when added to wine containing lead, produces a blackish precipitate.—*Ib.*

Steinhauser's Method of Making Artificial Magnets.—Professor Steinhauser has found, that the usual operation of double touch should be performed in a circle; and that, in magnetising horse-shoe magnets, two of them should be placed with their friendly poles together, and the touch performed circularly. Upon the separation of the two horse-shoe magnets, a considerable part of their force is lost, unless the great circuit is previously formed into two smaller ones, by joining the poles of each with a piece of soft iron. By these rules magnets of extraordinary power may be made.—*Edin. Phil. Jour.*

NOTICES TO CORRESPONDENTS.

J. M. Coldstream under consideration.—We are much obliged to J. L. for his trouble, but as his communications are not new nor very important, they must be deferred *sine die.*—M. W. will be superseded next week, as he will see by our observations under the article on "Dressing Goods."—Several communications will be inserted on a favourable opportunity.—We must apologise to J. T., Anderston, by stating that the nature of the question he proposed was the sole reason for our supposition. The "Scrap-Gatherer" will be cheerfully inserted.

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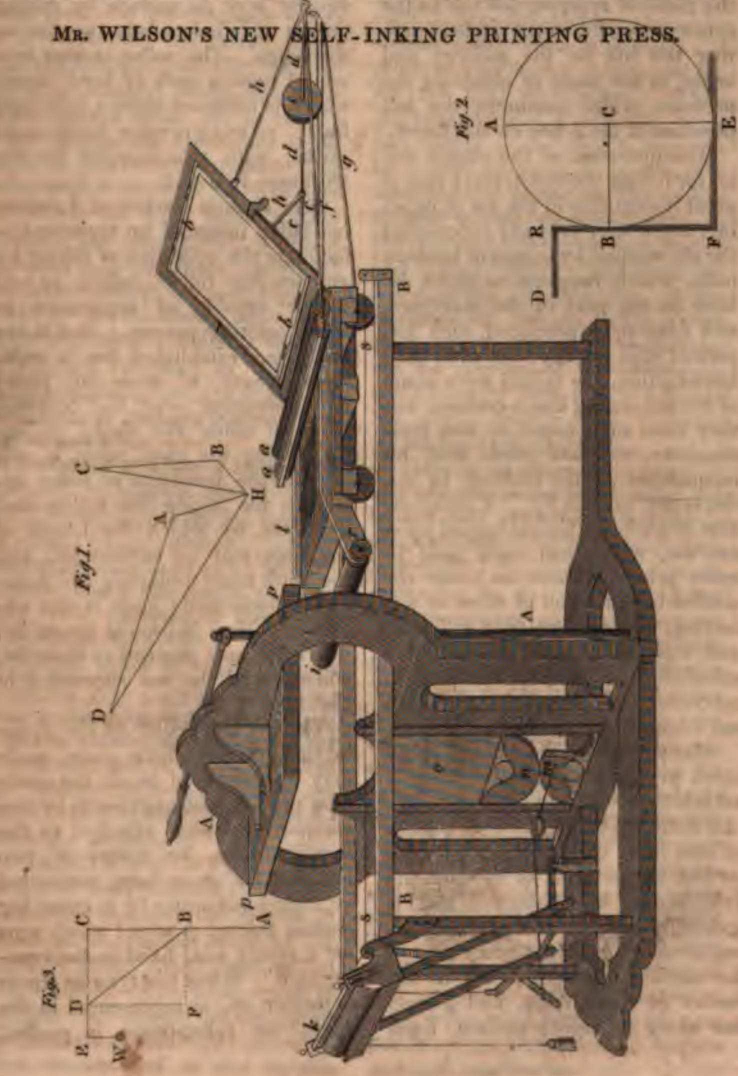
J. CURLL, PRINTER.

THE GLASGOW
MECHANICS' MAGAZINE.

"'Tis to the Pen and Press we mortals owe
All we believe, and almost all we know.
All hail! ye great preservers of these arts,
That raise our thoughts and cultivate our parts."

No. XXIII. *Saturday, 5th June,* 1824. Price 3*d.*

Mr. WILSON'S NEW SELF-INKING PRINTING PRESS.



NEW SELF-INKING PRINTING PRESS,

INVENTED BY

Mr. Hugh Wilson, Engraver, Glasgow.

This Printing Press, of which a very ingenious model has been constructed by the inventor, differs from the printing presses now in use in three particulars; first, in the mode of applying the ink to the types; secondly, in the mode of putting the ink on the rollers; and lastly, in the mode of obtaining the pressure which produces the impression of the types on the paper.

The invention of the elastic roller for inking the types, was a step of great importance in the art of printing, and it very properly superseded the old method by means of leathern balls, which required so much labour on the part of the workmen, and frequently produced such imperfect impressions. At their first introduction, the rollers were made of leather stuffed like a cushion, but they were soon found to lose their elasticity, to grow hard, and, by inequalities in the stuffing, to ink the types irregularly. A composition of glue and treacle spread upon canvass, which had been used in some printing-offices to cover the stuffed balls instead of skins or soft leather, was applied to a cylinder, and was found not less admirably calculated for the operation of a machine, than for printing by manual labour at the ordinary press.

Many devices were now fallen upon to supply the newly introduced inking rollers, regularly with ink. An inking table, formed of a plate of cast iron, with an oblong trough or box at one end to contain the ink, seems best adapted, and is generally used for this purpose. A metal roller, having a small part of its surface exposed, turns in the centre of this trough, and a steel bar along its upper surface, fixed by screws, regulates the quantity of ink given out. The elastic roller, being pushed up to the trough, receives a stripe of ink throughout its whole length, which is distributed equally over its surface by rolling on the table before being applied to the types. The roller is cast in a mould upon a core of hard wood, which is mounted upon a light iron frame, so as to revolve freely upon pivots, with two handles for the workmen to use it.

Mr. Thomas Parkin of London, has lately invented an apparatus to facilitate the operation of inking by composition rollers, which is said to be capable of application to most printing presses. But it has not been established for a sufficient length of time to prove its superiority over the common mode of using the elastic rollers. This being the case, room is still left for the invention of some apparatus for inking the rollers and the types, by which the labour of one man may be superseded, and the work more uniformly and accurately performed; such is the object of Mr. Wilson's invention, which we now proceed to describe, and we think he has succeeded in his attempt.

The ink is applied to the types in this press (and the same mode may be employed in all the common presses used at present) by two composition rollers attached to the tympan-frame, by means of two horizontal arms or bars, connected at their extremities by a cross bar passing through a wheel which runs on a centre bar, fixed in the type-carriage. When the tympan-frame is thrown up, as represented in the plate, the roller-frame is pushed

back by two connecting bars, extending from the tympan-frame to the extremities of the cross-bar.—By the motion produced in pulling or throwing up the tympan-frame, these two rollers, which have been previously inked by the distributing and feeding rollers, are drawn across the types which are thus inked in their turn. When the paper which is to receive the impression is put into the tympan, and the tympan-frame is brought down upon the types to pass under the press, the two composition rollers are again made to pass over the types. The two rollers being thus made to pass twice over the types before an impression has been made, produces an effect in inking them, equivalent to what would be produced by drawing the common roller four times over them; which is all that is reckoned necessary to distribute the ink equally over the types, so as to render the impression clear and uniform.

The paper and types being thus prepared to receive the pressure, the type-carriage is moved forward on wheels by the common winch or moving handle, so as to be brought directly under the centre of pressure. The pressure in this press is produced by means of an eccentric wheel, below the type carriage when in this position, working against a friction wheel, and forcing upwards a metal block which slides in grooves, and in its turn forces the type-carriage up against the platen, which is fixed, and thus produces the impression. The eccentric wheel is put in action by a handle or lever, similar to the one in common use, and the motion of this lever is communicated to the wheel by means of a universal joint. The eccentric wheel being made to describe one quarter of an entire revolution in producing the pressure, gives motion also to the feeding roller, which, by its means, is made to turn round a certain proportion of a revolution according to the nature of the work and the quantity of ink required.

The feeding roller is supplied with ink by means of a trough and scraper. While the impression is being produced, the distributing roller is brought in contact with the feeding roller while in motion, and receives a sufficient quantity of ink for the next impression. While the type-carriage is returning to its first position, the distributing roller is kept revolving by means of a small friction pulley on the end of it, and a cord stretched between the extremities of the carriage-frame, and is thus made to distribute the ink over the whole surface of the composition rollers. When the tympan-frame is thrown up to take out the impression, the rollers are again brought over the types, and the same operation is repeated which has been described.

There is another contrivance in this printing press, which must not be omitted. The tympan-frame is so constructed, that the paper which is to receive the impression, is made to revolve on its centre, and after having received an impression on one side in the manner described, it can be turned by the pressman in an instant, thrown down on the types, and an impression on the contrary side taken before the rollers could have been inked and the types prepared for such an operation in the common mode of printing. How useful this contrivance must be in printing jobs which require to be done in this way, must be obvious to those acquainted with it. The various other ingenious contrivances, however, exhibited in this self-inking press, must render it an object well worthy of the attention of engineers in this department of machinery.

Description of the Engraving.

A A, the press frame; B B, the type-carriage frame; *a a*, the composition rollers, within the roller-frame; *b b*, the tympan-frame; *c c*, the horizontal bars; *d d*, the cross bar; *e*, the wheel; *f*, the centre bar and its stay or support *g*; *h h*, the connecting bars; *i*, the distributing roller; *r*, the friction pulley; and *s s*, its cord; *k*, the feeding roller, scraper, and trough; *l*, the type-carriage; *m*, the eccentric wheel; *n*, the friction wheel put in motion by the eccentric wheel; *o*, the metal block sliding in grooves; *p p*, the platen.

ANALYSIS OF MR. CRICHTON'S PAPER ON EXPANSIONS.

Annals of Philosophy, April 1824.

In this paper Mr. Crichton has very successfully pointed out two errors, of considerable importance in the construction of thermometers, which have been hitherto overlooked by all experimenters and writers on the subject. These errors relate to the dilatation of mercury in glass, and to the absolute dilatation of the glass itself. In the commencement of his paper, the author has assumed the absolute dilatation of mercury at $\frac{1}{55.5}$ from 32° to 212°, or the interval from the freezing to the boiling point of water, this being the number assigned by M. M. Dulong and Petit, in their famous prize memoir on the subject. Had Mr. Crichton endeavoured to determine the absolute dilatation of mercury itself, in his usual accurate manner, instead of assuming their number, he would certainly have conferred an additional favour on the scientific world, as he has clearly shown the errors of these celebrated experimenters in the two former instances, and has consequently led us to suspect a similar error in the latter.

The mode in which M. M. Dulong and Petit ascertained the apparent dilatation of mercury in glass, was by heating a known weight of mercury contained in a glass vessel, carefully deprived of air and humidity, from 32° to 212°; then, by dividing the weight of the quantity of mercury contained in the vessel at freezing, by the weight of the quantity expelled by boiling, they obtained the quotient 64.8, and thence inferred that $\frac{1}{64.8}$ is the apparent dilatation of mercury in glass.

Mr. Crichton shows that this inference, though universally admitted, is erroneous, by the following illustration: Suppose that a vessel containing 64.8 parts by weight of a fluid, expels one of those parts by an increase of temperature; if we conclude, from this, that $\frac{1}{64.8}$ is the apparent dilatation of the fluid, our conclusion will be wrong, because it is evident that the dilatation of the part expelled has not been taken into account; for if this part were put into another vessel just sufficient to hold it at 32°, then $\frac{1}{64.8}$ part of it, or $\frac{1}{64.8}$ of $\frac{1}{64.8} = \frac{1}{4199.04}$ of the original quantity would in like manner be expelled. The same operation would require to be repeated with this and every subsequent part expelled, even to infinity, in order to arrive at the real dilatation of the mercury in glass.

Hence it is evident, that this real dilatation must be the sum of the

infinite series of these expelled quantities, which is $\frac{1}{63.8}$ only instead of $\frac{1}{64.8}$, as may be seen by the following formula. It can be very easily demonstrated *that the sum of an infinite geometrical series, having a fractional ratio, is equal to the quotient of the first term divided by the difference between the ratio and unity*, or $S = \frac{a}{1-r}$, when S denotes the sum of the series, a the first term, and r the ratio: Hence, in this case,

$$S = \frac{\frac{1}{64.8}}{1-\frac{1}{64.8}}; \text{ and } \frac{\frac{1}{64.8}}{1-\frac{1}{64.8}} \times \frac{1}{64.8}$$

$$= \frac{1}{64.8-1} = \frac{1}{63.8} = \text{the real di-}$$

latation of mercury in glass. From this also it is obvious, *that when the first term is the same as the ratio, and the numerator is unity, the sum of the infinite geometrical series is simply equal to the first term, having its denominator diminished by unity.* For $S = \frac{\frac{1}{n}}{1-\frac{1}{n}} \times n = \frac{1}{n-1}$.

It is thus evident, that, since the vessel, when heated to 212°, will contain only 63.8 parts, and when cooled to 32° leaves an empty space = 1, that this one part of the space, or $\frac{1}{63.8}$ of the volume of the mercury will be alternately filled up or left vacant, as the temperature is 32° or 212°; and that the real dilatation is equal to the quotient found, by dividing the quantity left in the vessel by the quantity expected by boiling, with unity for its numerator.*

Mr. Crichton next proceeds to show that M. M. Dulong and Petit fell into another important error in determining the dilatation of the glass, by taking the following false assumption for true: that the difference between the absolute dilatation of a fluid and its apparent dilatation in a vessel, must be the dilatation of the vessel itself. Hence they assign $\frac{1}{55.5} - \frac{1}{64.8} = \frac{1}{387}$ as the dilatation of glass, which would have been even erroneous, though $\frac{1}{63.8}$ were substituted for $\frac{1}{64.8}$, as the difference in neither case is equal to the real dilatation in the interval from 32° to 212°.

To ascertain the true dilatation in this and similar cases, the following consideration must be taken into account. If a certain quantity of mercury be expelled from a vessel subjected to a given heat, it is evident that somewhat more would be expelled if the vessel itself did not expand as well as the fluid. This additional portion must then be added to the quantity so expelled, and deducted from what remains in the vessel, to give the results which would necessarily happen if the vessel were not liable to expansion.

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* Dr. Ure in his Dictionary of Chemistry, where he describes the method by which M. M. Dulong and Petit obtained the dilatation of mercury in glass, states that it is precisely the plan employed long ago by the late Mr. Crichton and himself, and which gave the quantity $\frac{1}{63}$ for that dilatation. This result, obtained by these equally accurate experimenters, coincides with the number found by the mathematical theory given above, which the present Mr. Crichton had the honour of first pointing out.

Mr. Crichton ascertains this corrected quantity by employing the number denoting the dilatation of the vessel, to express its capacity at 32°; hence the same number plus unity, expresses its capacity at 212°.

Denoting this number by g, the capacities of the vessel at these points are expressed by g, and $g+1$; consequently, from the prescript, $63.8 - \frac{63.8}{g+1}$ is the corrected contents of the vessel, and $1 + \frac{63.8}{g+1}$ the true expelled quantity at 212°. Hence, the absolute dilatation of mercury is $1 + \frac{63.8}{g+1} \div 63.8 - \frac{63.8}{g+1} = \left(1 + \frac{63.8}{g+1} \times g+1\right) \div \left(63.8 - \frac{63.8}{g+1} \times g+1\right) = g + 64.8 \div 63.8\, g = \frac{1}{55.5}$; therefore, $\frac{63.8\, g}{g+64.8} = 55.5$, and $63.8\, g = 55.5\, g + 3596.4$, or $8.3\, g = 3596.4$; consequently, $g = \frac{3596.4}{8.3} = 433.301$; Hence, the absolute dilatation of the vessel is $\frac{1}{433.301}$ instead of $\frac{1}{387}$. And as it is known that the linear expansion is *nearly* * $\frac{1}{3}$ part of the expansion in volume, we have $\frac{1}{3}$ of $\frac{1}{433.3} = \frac{1}{1299.9}$, or, more exactly, $\frac{1}{1301}$ at 212°, for the elongation of a glass rod taken as unity, instead of $\frac{1}{1161}$ assigned by M. M. Dulong and Petit.

From these observations, Mr. Crichton concludes that the corrections for the expansion of glass, as applied to the air and mercurial thermometers, in their after detailed experiments on capacity for caloric, and the relative times of cooling, must, to this extent, have been erroneous. The fallacies which M. M. Dulong and Petit have overlooked, affect not only all calculations where expansion of glass should be attended to, but must have led to false results in the dilatations of the metals. By the preceding corrected method, the absolute dilatation of water, from its state of maximum density at 42.3° to 212°, was found to be $\frac{1}{22.76}$. This number is greater than that generally received; but as 39° has been assumed as the point of greatest density, instead of 42.3°, this circumstance (which is in effect the same as if 45.6° had been adopted) will, to a certain extent account for the variation. The same method gave for dilatation of air, by the increase of the temperature from 32° to 212°, $\frac{1}{2.7546}$. M. Lussac found it to be $\frac{1}{2.666}$, though by means which few will think capable of minute precision.

The vessel used in the trial made by Mr. C. was hermetically sealed at the extremes of temperature; this sealing was performed at an opening through a capillary fibre, and, to ensure complete dryness,

* The reason why we say *nearly*, is, because the linear expansion is less than $\frac{1}{3}$ part of the expansion in volume, as will be seen by the binomial theorem. Let 1 denote an original quantity which has by expansion become $1 + e$, its linear expansion will be found by extracting the cube root, thus:—

$(1+e)^{\frac{1}{3}} = 1 + \frac{1}{3}e - \frac{1}{9}e^2 + \frac{5}{81}e^3$ &c. Hence, from $\frac{1}{3}$ of the expansion e, $\frac{1}{9}$ of the square must be subtracted, then $\frac{5}{81}$ of of the cube added, &c. to infinity, to obtain the true linear expansion.

the vessel had been long heated fully to redness just before making the experiment. In their memoir, M. M. Dulong and Petit particularly mention, that they found all the varieties of glass which they used to have the same expansive power. Mr. Crichton, however, assures us, that every specimen differs more or less from another; trials by mercury give from $\frac{1}{63.6}$ to $\frac{1}{65.1}$, as the fractions expelled in the range from freezing to boiling water, even while the mercury has undergone the same rigorous and repeated boilings, these fractions indicating elongations of glass rods, by that increase of temperature, from $\frac{1}{1261}$ to $\frac{1}{1492}$. That crystal which is colourless, is commonly the most ductile and least expansible; but neither from its specific gravity, nor from its tint, as seen through the axis of a tube, can we estimate its expansive power; besides, it is commonly known that tubes of every description, in course of time, become less ductile; hence it is not improbable, that a change takes place in their rates of expansion.

Mr. Crichton states, that he was at first induced, by the highly sanctioned celebrity of the memoir, to peruse it with a view to establish a proper graduation of the higher part of the thermometric scale, and he promises, on some future occasion, to show, what that graduation ought to be for the degrees above 212°, and for those below 32°, beyond which two unalterable points, no scale hitherto laid down gives indications corresponding to those of the degrees within the limits of the primary thermic unit. Errors exist in the lower parts both of the mercurial thermometer, and in that filled with spirit of wine, and probably to a greater extent in the latter; as perhaps it has never been proved, that the expansive powers of alcohol are, for equal increments of heat, similar to those of mercury, particularly at the low temperatures reported by recent navigators, as having been observed in the polar seas. Indeed it would be no easy matter, except in climates where very low temperatures prevail, to determine the rates of the spirit thermometer, with reference to the mercurial one; but to attempt doing this by comparing the two instruments as at present constructed, would lead only from one erroneous system of graduation to another.

SOLUTION OF THE PORT QUERY.

In the data of this problem (see p. 272) there are more conditions than are absolutely necessary for its solution. In the following solution, the condition of the constant angular distance is not employed, as it is a consequence which necessarily follows from the rest of the data; and, of course, it is consistent with the other conditions, otherwise the problem would be impossible.

Let A, B, and H, Fig. 2, be the three harbours; let B C be the direction in which the ship from B sails, and A D that in which the vessel from A must sail.

Thus, since the distances sailed over in the same time by both vessels are as their rates of sailing, and since, if they tack at the same time and sail towards H, with the same rate of sailing continued, they both arrive at H at the same time, and A and B being two points in the line of their course in which they are at the same instant of time, it

follows that they must both sail over A H and B H in the same time, and hence their rates of sailing must be as A H to H B.

Again, let D and C be two positions, in which the vessels are at the same time, then A D and B C must be as their rates of sailing, as well as D H and C H; hence the sides of these triangles are proportional, and angle A = angle B. But B is given, and the line A H is given, hence A D is known. Hence the problem is determinate without employing the other condition, which follows as an inference, thus:

The triangles being similar, the angle D H A = the angle C H B; and adding the common angle A H C to both, the angle D H C = the angle A H B; hence the vessels are always seen under the same angular distance.

A. B.

Dollar, 4th May, 1824.

SOLUTION TO THE MILL-WHEEL QUERY.

Fig. 2. Put a = R F = 20 feet, the given fall of water, and x = A C = B C, the required radius of the wheel; then, because the velocities of falling bodies are as the square roots of the spaces descended, $\sqrt{(a - x)}$ will be as the momentum or force wherewith the stream strikes the wheel at B; and seeing this force acts at the end of the lever B C, we have $x \sqrt{(a - x)}$ for the power or effect which the water will have to turn the wheel; therefore, $\sqrt{(a x^2 - x^3)}$ or $x^2 \times a - x = a x^2 - x^3$ = a maximum. Consequently, $2 a x \dot{x} - 3 x^2 \dot{x} = 0$, by the principles of fluxions; dividing by $\dot{x}$ gives $2 a x - 3 x^2 = 0$; dividing again by x, gives $2 a - 3 x = 0$: therefore, $x = \frac{2 a}{3}$ = the radius of the wheel. Now a is = 20, $\frac{2}{3}$ of which is $13\frac{1}{3}$ feet = diameter of the wheel.

These calculations are to be considered as independent of the resistance of the wheel, and of the weight of the water in the buckets.

Query. If a weight of W (fig. 3.) tons, be suspended from E on the arm of a crane, A B C D E; it is required to find the pressure at the end D of the spur, and that at B against the upright post A C?

A. W.

Rothesay, 15th May, 1824.

MECHANICAL INVENTIONS AND USEFUL PROCESSES.

On forming a Communication with the Shore in Shipwrecks, and on instantaneous escapes in cases of Fire. * By Mr. John Murray, Lecturer on Chemistry, &c.

The invention of Captain Manby, beautiful and valuable as it is, is not always available. The rope frequently snaps, and it is difficult so to manage the required elevation, that the parabolic curve be adjusted to the distance and position. In a recent instance, off Whitby, the shot in the first experiment fell

* An apparatus for saving lives in cases of shipwreck, by Mr. H. Trengrouse, has been described in the 38th *volume of the* Transactions of the Society of Arts, p. 161. The projecting force used in the apparatus is a *rocket*, and it was found that a rocket of 8 oz. with a mackerel line attached to its stick,

and in the second the rope

disastrous circumstance of a
ck off the coast of the Isle
, (in which the unfortunate
d passengers, to the number
t thirty, were consigned to
ery abyss, at a distance from
re not exceeding fifty or sixty
first led me to consider the
bility of using the *common*
in like cases, and where the
e was not considerable.
ld enumerate many instances
wreck, where the means now
d would have been happily
t, as at Aberdeen, Montrose,

ny first experiments in the
r of 1817, made in the Isle
, with Capt. Garbett, R. N.,
eral other gentlemen, a mus-
let was employed, to which
ord was fastened, for it oc-
to me that whip-cord might
ng enough to bear a log-line,
is last to carry a rope on
In all my experiments,
r, the cord broke, and the
ue took place with silk, cat-
d hair-cord. I found that
ng, &c. snapped *within* the
I presumed, that if a sub-
could be found of sufficient
to carry the ball beyond the
orifice, it would finally succeed, but every experiment had similar terminations.

Towards the close of last autumn, I made experiments of a different kind, and with highly successful results, and since that period they have been repeated with the same success.

Arrows of hickory or ash, loosely fitting the calibre of the musket, are discharged with gunpowder, the charge being rather less than the usual quantity. The arrows are three or four inches longer than the barrel of the musket, and are shod with iron at the point, having an eye, through which the line is threaded. The lower end enters a socket, which must be in complete contact with the wadding of the piece.

A soldier's musket or blunderbuss, will doubtless serve the purpose better than a fowling-piece, but either will succeed; and it is important to observe, that the line *never snaps*, and the average distance to which the *arrow and a log-line* were projected, may be estimated at 230 feet;—though in *one* case an iron-rod was carried 333 feet, but in this instance the line was favourably placed. It is obvious that a smaller line would be propelled farther, and, when aided by the breeze, which would be most effectual, if the arrow was launched from on board toward a lee shore, the distance would be greatly extended, and in that case a plumed ruff might surround the shod summit of the arrow, inclining toward the eye.

It must also be remembered, that as the experiment may be repeated from on board, the distance assigned to the flight of the arrow would be *doubled*. The one from on shore should have a small float-board to preserve the buoyancy of the arrow on the waves, and in the dark and

to the distance of 180 yards, and
ound rocket in similar circum-
ranged 212 yards. The rocket
l in a copper instrument at the
a musket charged with a small
of powder without wadding,
purpose merely of directing and
the rocket. The rocket, when
by the powder, burns for a few
before it acquires sufficient mo-
to quit its situation, during
time the combustible would be
into the barrel of the gun, if it
ot prevented by a loosely sus-
valve, which opens to permit the
of the charge, but immediately
nd hinders the barrel from being
by the retrograde discharge from
et.—D. B.

stormy night, carry a port-fire, to mark its transit through the atmosphere, and guide the aim from on board.

Moreover, the life or other boat can generally, if not always, get sufficiently near the shipwreck, to propel the line on board by the method proposed.

In some parts of the country, a rope fastened to posts is stretched across rivers, by means of which letters, &c. are conveyed to the opposite side; now, after heavy floods this may be, and often is washed away, but, by means of this invention, the communication may be promptly restored.

This may also be employed to branch the harpoon in the whale-fishery. These experiments also explain the cause of the rope breaking in Capt. Manby's mortar, while they point out a method by which that misfortune may be remedied, and show that the *swivel* may be substituted.

There still remains another interesting application of the invention. The arrow may be projected over lofty buildings on fire, and carry a line attached to a lengthened *rope-ladder*, which could be drawn over the roof to the other side, and thus *instantaneously establish a fire escape* for the unfortunate inmates from the roof, (the last pedestal in cases of fire,) on both sides. The ends of the rope-ladder should be fastened into the pavement by means of iron-staples.

Account of an improved Glaze for Porcelain. By Mr. JOHN ROSE. *

THE common glaze for porcelain and the finer kinds of earthen-ware, contains glass of lead, which is extremely liable to combine with and degrade the more delicate colours, especially those obtained from preparations of chrome and of gold. This is particularly the case with those elaborate products which require to be repeatedly heated or fired.

The chief ingredient of Mr. Rose's glaze is pale flesh-red coloured feldspar of a somewhat compact texture, which forms veins in a slaty rock near the Welsh Pool in Montgomeryshire. When freed from all adhering pieces of slate and quartz, the feldspar is ground to a fine powder, and 27 parts of it are mixed with 18 of borax, 4 of Lynn sand, 3 of nitre, 3 of soda, and 3 of Cornwall china-clay. This mixture is melted into a frit, and ground to a fine powder, 3 parts of calcined borax being added previously to the grinding.

This new glaze has been examined by competent artists in London appointed by the Society, and highly approved of. They found that, from being softer than that used by the French manufacturers, it incorporates more completely with the colours, and renders them perfectly firm; whereas every artist knows that colours laid on French porcelain are extremely apt to chip off, crackle, and flake, if it is necessary to make them pass the fire a second time.

Chinese Method of making Sheet-Lead, and its Application to the making of Zinc-Plates for Galvanic Experiments.

THE method of making sheet-lead employed by the Chinese has not, so far as we know, been described in this country. The following notice of it we owe to our ingenious friend and correspondent Mr. Waddell, who, during his residence in China, obtained much information respecting the arts of that singular country. The operation is carried on by two men. One is seated on the floor, with a large flat stone be-

* Abridged from the *Transactions of the Society of Arts*, vol. xxxviii. p. 42.

m, and with a moveable flat stand at his side. His fellow-man stands beside him with a le filled with melted lead, and poured a certain quantity he stone, the other lifts the ble stone, and, dashing it on id lead, presses it out into a l thin plate, which he instantly es from the stone. A second ty of lead is poured in a similar r, and a similar plate formed, ocess being carried on with r rapidity. The rough edges plates are then cut off, and re soldered together for use. Waddell has applied this me-vith great success to the for-1 of thin plates of zinc for gal-purposes; and we have now us some of those made in anner. One of them is about th part of an inch thick, and only smooth on its surface, narkably uniform in its thick-

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of a New Stain for Wood, and a e Dye for Cloth. By JOHN HILL, *

new stain proposed by Mr. onsists of a decoction of wal-hickory bark, with a small ty of alum dissolved in it, in to give permanency to the Wood of a white colour re-from the application of this a beautiful yellow tinge, which liable to fade. It is particu-dapted for furniture made of particularly that kind of it is called birds-eye, and which monly prepared by scorching face over a quick fire. The tion of the walnut dye gives e even to the darkest shades, to the paler and fainter ones a somewhat greenish hue, the whiter parts various tints of yellow. After applying this stain to cherry and apple wood, the wood should be slightly reddened with a tincture of some red dye whose colour is not liable to fade. A handsome dye is thus given to it, which does not hide the grain, and which becomes still more beautiful as the wood grows darker by age.

"Walnut bark," says Mr. Hill, "makes the most permanent yellow dye for dyeing cloth of any of the vegetable substances used in this country, for that purpose, with which I am acquainted. Care should be taken that the dye be not too much concentrated: when this happens, the colour is far less bright and delicate, and approaches nearer to orange. It is hardly necessary to add, that the dye should be boiled, and kept in a brass, or some other vessel, into the composition of which iron does not enter."

* ridged from *Sulliman's American of Science*, vol. ii. p. 166.

On the application of Animal Empyreumatic Oil to the manufacture of Prussian Blue.—By M. HAENLE.

IN attempting to render useful the empyreumatic oil produced in the manufacture of the muriate of ammonia, M. Haenle has obtained with this oil a lixivium for the preparation of Prussian blue, as rich in colouring matter as that made with horns or with blood. It produces a blue which is neither less beautiful nor less lively. For this purpose, M. Haenle reduces the animal oil into carbon, and reddens this carbon with an alkali. In this way, says he, chemists may, by means of the empyreumatic animal oil, procure, in a short time, and without being incommoded with the least smell, a prussiate of potash fit for a re-agent. To do this, a Hessian crucible, holding from 8 to 16 oz. is filled half full with animal oil, and is placed among burning coals. As soon as the oil boils, it is set on fire, and the crucible is taken out of the fur-

nace, and placed under the chimney. In proportion as the oil consumes, more is introduced into the crucible; and, after all is burnt, the tarry product is calcined, till there rises from it a brown smoke, and till a part of it, put upon a cold body, hardens instantaneously, and presents the appearance of a porous and friable body without odour.—*Annal. Gen. des Sciences Physiques.*

On the Discoloration and Porosity of Coral Ornaments, and the method of preventing it.—By J. J. Virey.

It has been long known, that necklaces, bracelets, and ear-rings of coral, undergo, after being worn, a very remarkable change, and become extremely white and porous. Jewellers have no other remedy for this deterioration, than to remove the upper stratum of coral, till they come to a depth where no alteration had been produced.

This change had been ascribed to the action of air and of light; but this was found by experiment not to have been the case: and a discoloration never took place, unless when the coral had actually been worn as an ornament, in which case it has sometimes been completely whitened, when used only two or three times upon the naked skin, and in heated apartments. M. Virey, therefore, very properly ascribes the discoloration and porosity of the coral to the action of a particular acid which exists in the moisture of the body. According to the analysis of Thenard the acetic, according to Berzelius the lactic, and according to Berthollet the phosphoric acid, is found in it under particular circumstances.

In order to prevent this deterioration of coral, when used for the purposes of jewellery, M. Virey remarks, that it will be sufficient to impregnate it with a fat body, which will defend it from the immediate action of weak acids; and, for this purpose, he recommends that the coral should be digested in warm oil, or melted wax, so as to enable it to resist the action of the acid to which it is exposed.—*Journal de Pharmacie*, Avril 1821, No. IV. p. 193.

VARIOUS COMMUNICATIONS.

ON OUR PUBLIC MONUMENTS.

Sir,—I congratulate our townsmen on the re-appearance of the statues of these two worthy individuals, the Hutchesons, which now decorate the front of the Hospital founded and endowed by them. The number of our public monuments is not so great that we should hide them under a bushel, or keep from public view those that were intended for it.

There are various monuments of public characters placed in the choir of the cathedral, erected both by private individuals and by public subscription, as related in Cleland's Rise and Progress. There is a very fine one, also, placed in the Town Hall, the figure of W. Pitt, from the chisel of Mr. Flaxman; it is cut in white statuary marble, and is allowed to be an excellent likeness.

Among our more public monuments is the equestrian statue of William the Third, an excellent specimen of art, certainly, but one which is by no means seen to advantage in its present situation; indeed, it appears to be rather an incumbrance, owing to the crowded state of the street at that place, and from the obliquity of the entrance to the great London road, and, as well remarked by Z. in your last, the awkward turn in joining the Trongate.

The obelisk placed in the green, and erected to the memory of Lord Viscount Nelson, we are told, is an accurate representation, on a scale somewhat enlarged, of the one brought from Heliopolis, by Augustus, and placed, by him, in the Circus Maximus, and now erected in the Piazzo del Popolo, at Rome. The pedestal that has been adopted, is

medium between the pedestals obelisk and the one erected in the Church of St. Giovanni, in , the former being too low, and ter too much elevated. This ent is 142 feet 6 inches high, was erected by public subscrip-

statue of Sir John Moore, erected ge's Square, is indeed a beautiful workmanship, executed in bronze, sed upon a pedestal of Aberdeen This statue is, also, from the Mr. Flaxman, and was erected neral subscription of his towns- The figure and pedestal accord ith one another in proportion, of materials which will be as as his fame.

e is, also, a chimney in Miller- yclep'd by some of your Corres- ts a classical column, for what I know not, but it is certainly n its chasteness, nor its propor- or the base projects over the pe- and the top is too heavy for the h of the shaft. I am apt to think fashioned gun-mouthed cone is st suitable shape of the two, for pose of a chimney, and not so o yield to the wind as this top- olumn. This chimney is, more- edicated to the memory of James he great improver of the steam- to whom this country is so much d. But that the *chimney* of a ngine should be dedicated to him, ng quite preposterous in my opi- for we might as well dedicate the the bottle-work to some of the Phœnicians, who were reputed st discoverers of glass-making. att, however, stands in no need a mode of commemorating his or his name will rise, and be along the stream of time, when uld-be monument and its builders g levelled in the dust.

I am, Sir, your's, &c.

X.

ON SOUNDINGS.

—It is a law in hydrostatics, that press equally on all sides, and it roved that water is almost in- ssible; now, if a piece of lead be into the deepest part of the sea, go to the bottom; for when the immersed, it will be equally on all sides, and, consequently, it will continue to sink, unless the water, by the pressure of the superincumbent mass, has become of the same specific gravity as the lead. This, however, can never happen, because the little compressibility of water will never allow it to occupy much less bulk.

From what I have stated, it would appear possible to sound at any depth; but many speculations which appear possible in theory are found to be impossible in practice. The cause why soundings have failed in giving an idea of the true depth of the sea, may be owing to the currents below the surface. We have all seen a spider, suspended from the cieling of a house, driven considerably from its perpendicular course by any small current of air in the room, indeed so much so, as to prevent its reaching the floor. In a similar manner, may not some current in the sea prevent the lead from gaining the bottom?

I am, Sir,
Your's, &c.
T. G.

Paisley, 21st May, 1824.

HELPS TO READ.

Sir,—Reading, although perhaps the most grateful task in which man or woman can engage, is yet, it must be allowed, very injurious to the sight. The great Sam. Johnson's eye, we know, was none of the most microscopic; and the immortal Milton read out his eyes quite.

For my own part, Sir, I found myself, of late, assimilating too much in this point to these renowned men. My visual balls were grown so fluid and tender that to look on a book was to me a perfect vexation. But among books I must be, else my mind will soon become a cage of unclean birds.

In this sad dilemma, I fell a cogitating whether it was not possible to render the too bright *foolscap* more tolerant. I peruse the huge volume of nature, argued I, and it does not thus grieve my sight, but every page of her volume is green; ergo, could I but render this foolscap green, it would be equally agreeable to my sight. Having come to this conclusion, I made not a few experiments, but still to no avail. At length, I procured a pane of window glass, reposed it upon my book, and began to read through it, when, to my indescribable joy, I found that I could now, undazzled, pore upon my book, for hours together! nay, be-

lieve me, my sight is now almost completely restored!!

This discovery, Sir, it is philanthropy to make public; for as the glass may, with equal propriety, be used in the closet, in the domestic circle, or in the more public coffee-room, its efficacy may be said to be universal.

L. M'L.

MISCELLANIES.

THE SCRAP GATHERER;
OR,
A Selection of Facts worth knowing.

" Science is not Science till revealed."

No. 1.—*Natural Architecture.*—Is not nature the school where architecture was originally studied?—And what has been added to this by the whole Grecian school?—A capital to ornament the column of nature; of which they could execute only a model; and for that very capital they were obliged to a *bush* of Acanthus. How amply does nature repay those who study her wonderful works!

2.—*The Orders of Architecture* have different characters from several causes, and chiefly from the different quantities of matter in their entablatures. The *Tuscan* is distinguished by its *severity;* the *Doric* by its *simplicity;* the *Ionic* by its *elegance;* the *Corinthian* by its *lightness;* and the *Composite* by its *gaiety.* To these characters their several ornaments are suited with consummate taste.

3. *Concave and Convex in Architecture.* " Among all the figures of Architecture, there are none that have a greater air than the concave and the convex; and we find in all the ancient and modern architecture, as well in the remote parts of China, as in countries nearer home, that round pillars and vaulted roofs make a great part of those buildings that are designed for pomp and magnificence. The reason I take to be, because in these figures we generally see more of the body than in those of other kinds. There are, indeed, figures of bodies where the eye may take in two-thirds of the surface; but, as in such bodies the sight must split upon several angles, it does not take in one uniform idea, but several ideas of the same kind. Look upon the outside of a dome, your eye half surrounds it; look upon the inside, and at one glance you have all the prospect of it; the entire concavity falls into your eye at once; the sight being at the centre that collects and gathers into it the lines of the whole circumference. In a square pillar the sight often takes in but a fourth part of the surface; and in a square concave must move up and down to the different sides before it can be master of all the inward surface. For this reason, the fancy is infinitely more struck with the view of the open air and skies, that passes through an arch, than what comes through a square, or any other figure."

4. *Astonishing Power of Steam.*—" If a small quantity of water is put into a tea-kettle, and placed on the fire, it will disappear in a short time, having escaped in the steam. But if its escape be prevented by stopping up the spout and crevices, it will force its way, by bursting the vessel in which it was confined. If the steam of boiling water be at liberty, the water never attains more than a certain degree of heat, which is called the *boiling point;* but if confined in a close vessel, the additional fire not escaping, the power of the steam is increased, it reacts upon the water, and raises the heat so much higher, that it would keep lead in a melting state; and so penetrating, that it softens the marrow-bone of an ox in a few minutes."

5.—*Steam Engines.*—According to the statement of a recent lecturer on the steam engine, it appears, that there are, at present, in effective operation, in the United Kingdom, about *fifteen hundred steam engines* of various powers; from one, two, or more horse-power, up to one in Cornwall, of *six-hundred horse-power.* Now, estimating the power of a horse, in comparison with man, as 5½ to 1, and calculating that a steam engine works, daily, the whole twenty-four hours, whereas horses can only work eight, and men ten hours per day, it will be evident that this engine effectuates, daily, the work of *eighteen hundred horses,* and of *men,* the work of *nine thousand.* Estimating, again, that the average power of the fifteen hundred steam engines in this country, is that of forty horses each, working, daily, twenty-four hours; then

our performed by the whole, will l to *one hundred and eighty thousand* and of men, the labour of about lion. The total number of steam in France is only *three hundred.*

trical Apparatus.—Considerable enience has been found to arise ie weak state of electric apparatus p or foggy weather. To remedy Mr. Ronalds has introduced a pirit lamp under the cushion of a ical machine, and another under me conductor, which he states es the power in a high degree; chine by this means performing notwithstanding the unfavourable f the atmosphere. Even in the r season, the machine is liable to ewhat damp, and it is frequently ore the fire for the purpose of it.

ll favourable times we should re- ad electrical machines to be placed the sun may shine upon them, have found, by experience, that ver of the machine is improved in degree by the action of the sun's *Journal of Arts and Sciences.*

ention of Dry Rot.—The follow- nedy against dry-rot has been ed by Mr. Baker, of Hampstead: wo ounces of white arsenic in , dissolve it by boiling in one of soft water; if boiled in an tinned vessel, add half an ounce er filings, but if in an untinned essel, the filings are unnecessary; art of size and half a pound of a small quantity of fresh-slaked fted pretty fine; beat them well paste, which is to be dissolved e above solution, gradually add- ing the process, (by small por- as much more of the pulverized will give the whole a proper diluted) body, to be laid on with er's brush. New work when as a preventive, should be with the composition at least fter well drying the first coat.

ANICS' INSTITUTIONS.

Newcastle Institution for the In- of Mechanics, &c. in the arts nces, has already to boast of 220 rs, and it is confidently expect- efore the end of this year the will amount to 350. J. G. Lambton, Esq. M. P. with his usual liberality, has presented the Institution with £50, and several smaller sums have been received from different gen- tlemen in the neighbourhood; besides a considerable quantity of valuable books.—*Glasgow Chronicle.*

The Manchester Mechanics' Institu- tion has been successfully established, by means of public subscriptions and do- nations. We observe from a list of the donors and subscribers, published in the Manchester Herald, that one gentleman has given a donation of 20 guineas; 37 gentlemen have given 10 guineas each; one gentlemen 5 guineas: and another 2; four gentlemen have given donations of 2 guineas each annually, and 101 gen- tlemen donations of 1 guinea each, per annum. The sum thus obtained for the present year, is £522 7s., of which £115 10s. is annual donations. This sum is, of course, independent of the subscriptions of the mechanics them- selves, and is a very handsome and gene- rous addition to the funds of such a laudable institution.—*Ed.*

A writer in the same paper states, that the goods dressed by means of gas have the appearance of being scorched, and are made too tender by that process.

COAL AND OIL GAS.

In the account of the coal and oil gases, in our last, the selling price of coal gas in Edinburgh was stated at 12s., and in Glasgow, as 8s. 6d. per 1000 feet. This estimate would make the Edinburgh gas appear considerably dearer than the Glasgow gas, which, however, is not the case, to such an ex- tent; and the difference arises from the mode of calculating the selling prices. 12s. in Edinburgh is the price of gas sold by the meter; and if we calculate by the same rule, the price in Glasgow, by the meter, would be, as far as can be ascertained, from 10s. to 12s., instead of 8s. 6d., which is not the meter price, but the average of what the Company actually receive for every 1000 feet which they make, whether consumed or wasted. In Glasgow they have, in fact, no meter; and the price, per 1000 feet, is only calculated by comparing the whole quantity of gas made at the works in a year with the annual receipts. The average price in Edinburgh, calculating by the same rule, is about 8s. 11d.; s- that the coal gas is very little dearer i

Edinburgh than in Glasgow. The expense of manufacturing the Edinburgh gas was, also, stated at from 7s. to 8s. This, however, includes interest on capital, which, if deducted, reduces the cost price to somewhat less than 5s.

Bauman's Dynameter for measuring Magnifying Powers.—This simple instrument consists of a small tube, having within it a mother-of-pearl scale, divided into 10ths of a line, the divisions being read off with a small eye glass at the other end of the tube. When distinct vision is obtained in the telescope, the small tube is held against the eye-glass of the telescope, and the observer sees how many divisions of the scale are occupied by the small luminous circle in the centre of the eye-glass. The clear diameter of the object-glass is then divided by this quantity, and the quotient is the magnifying power. This apparatus was first described in the *Ephemerides de Berlin* for 1775. Mr. Ramsden had, fifteen years before, constructed a similar instrument, in which he measured the diameter of the small luminous circle by the extent of the two images formed by two semi-lenses.—*Bibl. Univ.*

SILK MANUFACTURE.

The Society of Arts being desirous of adapting the premiums offered by them for the encouragement of the silk manufacture, to the present exigencies of that most important department of the productive industry of the country, have arranged them as follows:—

Winding Raw Silk.—To the person who shall invent and produce to the Society, a method, better than any hitherto known, of winding raw silk, that is any degree sticky in its gum, or brittle in its texture, without injuring its colour or texture, or altering its weight, and at a cost not exceeding that of the ordinary methods—*the Silver Medal, or Twenty Guineas.*

Organzine Silk.—To the person who shall invent and produce to the Society, a method by which to organzine silk equal in quality to the Italian throw, at an expense not more than two-thirds of the current price of throwing—*the Gold Medal, or Fifty Guineas.*

Preventing the Watering of Plain Silk.—To the person who shall invent a method of preventing plain silks from being watered in the loom, without the use of a knee roll—*a Silver Medal, or Fifteen Guineas.*

Machine for Silk Weaving.—To the person who shall invent and produce to the Society a machine to weave figured silks for garments, shawls, handkerchiefs, &c., of patterns equally fine and rich as those now made in France, at less expense than the montures, &c., now in use, also, affording greater facility for changing the pattern, and requiring less manual labour in working—*the Gold Medal, or Fifty Guineas.*

Dying Silk of a Pink and Rose Colour.—To the person who shall invent, and discover to the Society, a process of dying rose and pink colours in silks, without the use of safflower, by a substitute of British Colonial growth, which shall produce colour equally beautiful and permanent, and at an expense not more than two thirds of the current price—*the Gold Medal, or Thirty Guineas.*

Improved Black Dye for Silk.—To the person who shall invent and discover to the Society, a black dye for silk, superior in colour and durability to any at present in use—*the Gold Medal, or Fifty Guineas.*

Dying with Lac Lake.—To the person who shall invent, and discover to the Society, a process for dying silk with Lac Lake, or with the colouring matter of Lac, superior to any now in use—*the Gold Medal, or Fifty Guineas.*

NOTICES TO OUR READERS AND CORRESPONDENTS.

A mechanical wonder! Three wheels working into one another, and all turning the same way, will appear next week.—G. B., Hamilton, asserts that the common rule for finding interest at 4 per cent. by multiplying the sum by the days, and dividing by 9125, is easier than W. C.'s mode, and we are much of the same opinion; at the same time, we wish to give all due encouragement to the ingenuity of our Correspondents, and if G. B. can find a simpler rule than either, we will insert it. His communication on Soundings, as well as that of J.P., not conveying any very conclusive ideas on the subject, we have *closed* the discussion, by inserting T. G.'s letter, which seems to account for the difficulty in finding them.—L. M'L.'s *recipe* wont do.—S. Y. will be inserted.—J. T. will be inserted in the original order.

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J. CURLL, PRINTER.

THE GLASGOW
MECHANICS' MAGAZINE.

" With constant motion, as the moments glide,
Behold, in running life, the rolling tide!
Yet none can stem by art, or stop by power,
The flowing ocean, or the fleeting hour."—*Elphinstone.*

No. XXIV. *Saturday*, 12*th June*, 1824. Price 3*d*.

MECHANICAL WONDER IN HOROLOGY!

Invented by Mr. William Cooper, Hamilton.

Fig.1

Fig.2.

Fig.3

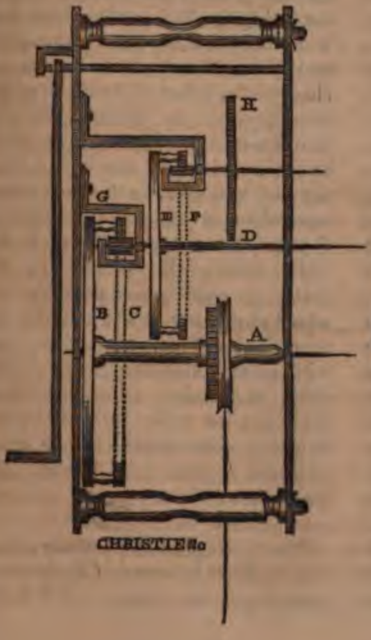

Fig.4

MECHANICAL WONDER IN HOROLOGY!

Invented by Mr. Wm. Cooper, Hamilton.

Three Wheels working into one another, and all turning the same way.

Mr. Editor,—I have sent you a description of an Eight-day Clock lately invented by me, that will show the hours, minutes, and seconds, with only *three wheels and two pinions* in the whole movement; if you deem it worthy of insertion in your Magazine, it is at your service.

In giving a description of this clock, perhaps it may be proper first to state, that it is a common notion amongst mechanics, that two wheels cannot run or work into one another, and both turn the same way, without an *intermediate* wheel. In this clock, however, it will be observed that the three wheels are made to work all one way, without any wheel of *that kind* whatever. The two largest, or first and second wheels, must be made in the following way: the teeth must be cut in the inside of the rim, as represented in fig. 1.

Fig. 2, represents the arms of the wheel, which must be made in a separate piece from the rim; and four pillars, or studs, about one-fourth of an inch long, must be turned and rivetted into the round pieces at the ends of the arms, as represented in fig. 2. The rim must be screwed into the pillars with four small screws, and the rim then turned true and cut. When the wheels are thus finished, the arms will stand one-fourth of an inch from the rim.

Fig. 3, shows a side view of the clock-work. A, is the axle of the great wheel, which turns round in twelve hours, and carries the hour hand. B, is a view of the arms of the great wheel, and the dotted line C, shows the edge of the rim of the great wheel. D, is the axle of the wheel to which the minute hand is attached, and which carries round that hand in one hour. E, is the arms of the wheel, and the dotted lines, F, the rim. H, is the crown wheel, which carries round the seconds-hand in three minutes. G, is what is technically denominated a bridge; it is screwed to the back frame-plate, and it may be cast or knee'd in such a manner, that the axle D, shall run into it. That part of it nearest the wheel must have a hole, as shown at O, so large as to allow the pinion head to go through, and to admit the back pivot into its hole, and the pinion head into the teeth of the wheel C; the wheel above runs in the same way.

Fig. 4, shows the wheel work, with the number of the teeth and pinion-leaves. I have also given a view of the dial, (page 376,) and as there is no work between the fore frame-plate and the dial, the one can be put close to the other. The clock might be simplified by making the dial the fore-frame, which may be easily done, by rivetting the pillars into the dial, and making the back-frame moveable, in the same manner as the fore-frame in a common clock.

In cutting the wheels, as the cutter cannot pass through the wheel altogether, it will cut the one side deeper than the other; but with an equalling file, uncut on the sides, and only cut on the edge, they can be made both alike deep in a very short time. I have made a wheel of this kind myself, and find it but a short process.

I am, Sir,
Your's, respectfully,
Wm. Cooper, *Clockmaker.*

Hamilton, 8th March, 1824.

THE GLASGOW

MECHANICS' MAGAZINE.

"With constant motion, as the moments glide,
Behold, in running life, the rolling tide!
Yet none can stem by art, or stop by power,
The flowing ocean, or the fleeting hour."—*Elphinstone.*

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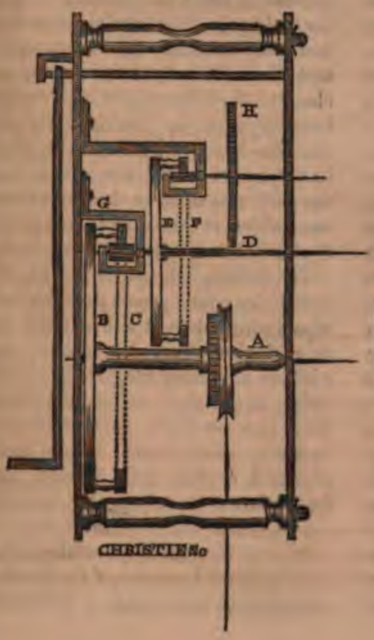

Fig. 4

Imagining that he had now discovered the grand secret of the Pythagoreans, and being highly elated with the discovery, he published it in the year 1596, with the title of *Mysterium Cosmographicum*.

The next step which he took was one of the greatest importance, as it led to those real discoveries to which he now owes his fame. Having sent a copy of his book to the celebrated Danish astronomer, Tycho Brache, he received an answer, which, with the greatest candour, he relates in the second edition of his work, and which runs as follows;

"The drift of the letters of Brache was this, that having laid aside those speculations which were derived *a priori*, I should rather turn my mind to the consideration of those observations which he at that time presented; and that, having made my first advances in them, I would at length arrive at the causes."

Tycho saw enough in the work of Kepler to convince him of his extraordinary genius, and he therefore wished for nothing better than to have him for a disciple. Accordingly, he prevailed with Kepler to reside with him, and to assist him in his astronomical labours. Soon after this, Tycho paid the debt of nature, and left Kepler sole master of the field.

The ancient astronomers had supposed that the planets performed their revolutions in orbits perfectly circular, whose common centre they at first believed to be occupied by the earth. More accurate observations, however, soon obliged them to remove the earth to a greater or less distance from the centre of this supposed revolution, to account for the variation in the apparent diameters of the planets, from which it was necessarily to be inferred, that their distances from the earth likewise varied. Tycho Brache, who was prevented by religious scruples, from adopting the Copernican system, still considered the earth as the centre of the universe, with the followers of the Ptolemaic system, but made all the other planets revolve round the sun, while it revolved round the earth. The numerous observations which he had made on the motions of the planet Mars, furnished Kepler with data, which, in conjunction with immense calculations, at last convinced him, that all these motions could not be explained by the supposition of a circular orbit, in whatever situation the sun might be supposed to be placed. Unwilling to disturb, as he thought, the harmony, beauty, and simplicity of nature, he calculated and re-calculated different orbits with astonishing perseverance, but all was in vain; till at length he was driven to the conclusion that the common ellipsis, by placing the sun in one of its foci, agreed most perfectly with the results of all his calculations and observations. This was the first grand step in the march of discovery, and is commonly denominated the first law of Kepler. Having afterwards determined the dimensions of the elliptic orbit of Mars, he compared together the times which the planet employed in performing a complete revolution from the extremities of the greater axis of the ellipse or line of the apsides, and performing a given part of this revolution, and found that these two times were always to each other, as the whole of the area of the ellipsis to the area of the elliptic sector, contained by the arc described by the planet and the radius vector drawn from both extremities of the arc to the sun. The same proportion was also verified in all the other planets; and it was likewise found, that the same law took place in the revolutions of

the satellites around their primaries. This is usually termed the second law of Kepler, and may be thus shortly expressed, "The radius vector, or line drawn from the sun to a planet, describes equal areas in equal times."

(To be continued.)

ON ILLUMINATION BY ELECTRICITY.

(By a celebrated Professor.)

WHO would have ventured, twenty or thirty years ago, to assert that that little flame of hydrogen gas, which was called the philosophical lamp, would light, in the nineteenth century, streets, public places, whole cities! Yet this is what we now see; and this mode of illumination is justly considered excellent. But I am firmly convinced that it will one day be succeeded by a more perfect and less expensive illumination: I mean by electricity.

I support this prediction on the experiments which have occupied me several years.

Among a great number of instructive or amusing experiments on light, and to which I dedicate the evenings, I have attempted to demonstrate to my hearers, that in the same manner as an electric shock may be continued, or rather repeated, as it were, *ad infinitum*, so also a luminous electric spark is susceptible of being perpetuated an indefinite number of times, if circumstances (a dry atmosphere, conductors well insulated, and placed at a convenient distance,) are favourable, or disposed with some address. I wished, at the same time, to inform myself to what degree the multiplication of a ray of electric light may extend; and if it would be possible, by means of this multiplication, to produce a continual illumination.

With this intention, I fixed to the wall of my lecture room, beside six large glass panes, furnished with lozenges of tin foil, about a hundred leaden balls, covered with wax, and I suspended to it also a silk string, about forty feet long, surrounded with little laminæ of tin foil. These insulated pieces of metal were, at the most, an inch from each other, and the apparatus communicated by means of a small metal chain, with the conductor of an electrical machine, so that each spark would be repeated near a thousand times. The machine, which I turned rather briskly, to obtain a constant torrent of light, was good, but of a moderate size, for the plate was not above two feet in diameter, but the beautiful light which it produced surprised both myself and my auditors. It was like a bright moonlight, which spread over the whole lecture room. Afterwards, when instead of connecting with the floor the extremity of the last conducting chain, I made it end in a receiver void of air, on an air-pump into which the electric light was to pass between two balls, distant about three inches from each other; the light became so strong that we could read a small hand-writing in the middle of the room. The light even appeared to become stronger during the continuance of the experiment.

I had thus succeeded in obtaining, without any combustible, a bright and agreeable light; a light more ætherial than that of gas; that is to say, that a very large room was lighted by sparks, repeated or propagated, without this torrent of sparks appearing to grow weaker at the end. I might certainly have repeated these sparks in a second

and in a third room, and perhaps lighted the whole building, if it had been possible to dry sufficiently, by the heat, the air of all these rooms; and thus to insulate the whole apparatus. This trial is certainly very imperfect; it, however, shows that a considerable illumination may be produced by a very moderate expense of electricity; but it will, perhaps, be found, on reflection, that so simple a process, even if it should be improved, is neither sufficient nor admissible; for not to mention that the sparks, repeated in a confined space, emit, after some time, a disagreeable smell, corrupt the air, and even render it injurious to respiration; the atmosphere cannot be sufficiently dried, so that it will no longer be a conductor of electricity, and then the sparks will become fainter, and even be extinguished after some time; of this I have convinced myself, by repeating the experiment several times; in damp weather, even when the room was heated, I could produce only a very moderate illumination. In the open air, or in the streets, it would have been impossible.

But if the sparks are conducted, confining them in glass tubes impenetrable to the air, or in glass globes communicating with each other, and if the shining lozenges are introduced in the insides of these tubes and globes, then the inside of this apparatus remaining constantly dry, the external humidity will be nearly indifferent.

But even then the current of electrical light is still insufficient, and inapplicable to illumination properly so called. For if the luminous globes, or tubes, are not multiplied in such a manner that the expense becomes too considerable, we shall never obtain more than a faint moonlight. We must, therefore, still have recourse to chemical *means*.

Now, there are kinds of air in which the electric light is more brilliant than in atmospherical air. According to my experience, it is not in oxygen gas, as might be presumed, but principally in hydrogen gas, in nitrous gas, sulphurated hydrogen, and carburated hydrogen. But a compound gas, like the three last, cannot be employed to form an electric atmosphere, because it gradually decomposes. Thus hydrogen, even when it is not very pure, since the sparks purify it, remains the only gas to fill the tubes or globes into which the electric light is to be conducted from one lozenge to the other. And this introduction of gas, which is made once for all, is neither difficult nor expensive in the quantity required. In hydrogen the light of the electric spark is at least doubled, without losing any thing of its size or of its vivacity. But if the hydrogen gas is dilated to a certain point, which may be obtained by expelling a part of it by heat, we obtain at the same time a more lively impulsion in the spark, and increase so much the more the electric light. I have convinced myself of this also by experiments on a small scale.

The establishment of an electrical illumination in glass tubes, filled with rarefied hydrogen gas, appears to be practicable, with some perseverance and some technical knowledge. No danger is to be apprehended, the hydrogen cannot burn, nor the electrical sparks inflame, when the former is inclosed in vessels, and separated from the atmospheric air, and the latter is excluded by the glass. The first establishment of the apparatus, that is to say, of the glass tubes, and a large electrical machine, moved by a mechanical power, would cost less than the apparatus for lighting with gas; and the subsequent expense

would be hardly any thing, since it would be limited to the mere superintendence and some care. Some difficulties in the details, perhaps too the prejudice that might at present delay the execution, will be surmounted or dispelled one day by the progress of a bolder and more enlightened philosophy.

I shall not go farther into the details, as I have not yet had the opportunity of repeating my experiments on a great scale. I with diffidence submit these first trials to the opinion of connoisseurs.

SINGEING MUSLIN WITH GAS.

MR. EDITOR,—I am induced to address you, in consequence of some letters which have appeared in your Magazine on the subject of singeing muslin with inflammable gas, and particularly by one from your Correspondent Mr. Hall.

On this subject allow me to state a simple fact: In December, 1822, a respectable manufacturing house in Glasgow, whose gas pipes I had fitted up a short time before, sent for me for the purpose of inquiring whether the coal gas might not be employed to singe muslin. After some conversation, I said I thought it might be done: but, if they would allow me, I would consult Messrs. Hart on the subject. To this they consented, and on those gentlemen I accordingly called. Without entering here into any details of the ingenious plans with which they furnished me, suffice it to say, that I fitted up an apparatus after their directions, which was put in use by the manufacturing house in question, and given up by them, on account, as I understood, of the wiry appearance of the cloth singed by this means; a quality of the process which Mr. Hall, perhaps with more propriety, ranks among its advantages.

After this plain statement, it will be perceived, that, in this quarter at least, Mr. Hall cannot challenge the right patent to singeing with gas. His amended patent was taken out only last year.

The subject is of importance to manufacturers; and I am anxious that justice should be done our ingenious and meritorious townsmen.

On these grounds, I hope that you will give this communication a place.

I am, Sir, your's, &c.
JOHN FERGUSON.

34, Stockwell, 9th June, 1824.

PRACTICAL PROBLEMS IN MENSURATION.

Given a square board. Required to cut off the corners, so as to form an octagonal board.

Rule 1st. Multiply the constant decimal .4142 by the side of the given square, the product is the side of the octagon. The half of which taken in a pair of compasses, and set off either way, from the middle of each side, will mark the corners to be cut off.

Rule 2d. Multiply the constant decimal .2929 by the side of the given square, the product is the distance to be marked off from each corner, to have the side of the octagon.

If any of your country mechanics have a pony at grass, a solution of the following query may be of service to them:

What must be the length of a horse's tether, so that he may eat only an acre of grass, after being flitted once and again, the end of the tether being always fixed at the edge of the uneaten grass?—*Ans.* 26.355266 yards. RUSTICUS.

MECHANICAL WONDER IN HOROLOGY!

Invented by Mr. Wm. Cooper, Hamilton.

Three Wheels working into one another, and all turning the same way.

See the Description, page 370.

A VERY SIMPLE FIRE ESCAPE.

Sir,—In Number XIV. of your Magazine, there is a description of two fire escapes, but as the following is more simple in its construction, and more ready in the case of an emergency, if it meet your approbation, its insertion may be of service to those who are desirous of saving their fellow-creatures from the rage of the devouring element.

It consists of poles, six feet long, with screws fixed upon the end of each, and a long virol of copper to *cover the joint* and to strengthen it; the poles are numbered; the second is a little stronger than the first; the third stronger than the second; and so on to the last. On the top-pole, a small iron frame is screwed with two small wheels to run up the wall, and two large hooks to catch upon the bottom of the window in the inside. To the frame there are also fastened a block and pulley, which hang over the window by a short chain. A rope runs over the pulley, and to one end of the rope is fixed a basket or cradle.

Two men can easily run the poles up the wall of the building, while a third screws them in as the apparatus is pushed up, and in a few minutes it may be made to reach the window from whence the escape is to be made. The person at the window being certain that the hooks are properly fixed, the basket is then drawn up by the men below; he then steps into the basket and is lowered to the ground; his whole weight, while descending, rests upon the hooks, and not upon the poles, which are merely employed to convey the apparatus up to the window.

If one of these escapes were attached to each fire-engine, and men appointed to work it, it might be the means of saving the life of many an individual.

I am, Sir, your's,

M. A.

Fig. 1

Fig. 2

Description of the Figures.

Fig. 1. represents a side view, and fig. 2. a front view of the apparatus, in the situation in which it ought to be placed, to effect an escape from a window. A A, the wheels to run up the wall. B B, iron hooks to catch the bottom of the window. C, the support for the wheels and pulley. D, the block and pulley, whose centre forms the centre of the wheels. E, the rope to which the basket is fixed for descending. F F, the rods.

ON THE TIDES.

The phenomena of the tides may be conveniently arranged under three heads, *viz.*

I. Those which occur twice in the day.

II. Those which occur twice in the month. And

III. Those which occur twice in the year.

1st. The first phenomena which

strike the most careless observer with respect to the tides, are these: The sea flows from the south towards the north, by a gradual swell, for about six hours, and entering the friths of rivers, as well as bays and harbours, drives back the fresh waters of the former, and raises them in a heap, while it overflows the spacious shores and channels of the latter, till it reaches its maximum, or highest elevation. After this it seems to rest for a little, and then begins to ebb or retire in a contrary direction for the same time, during which the collected waters gradually disappear, and leave the bays and harbours to their former states, while the rivers resume their natural course as before. Having arrived at its minimum, or lowest point, it soon begins to flow in the same manner; and continues thus to flow and ebb alternately, till the end of time. A more attentive observation of these phenomena has discovered, that, while the sea thus ebbs and flows twice a-day, yet, on every successive day, this takes place later than on the preceding, by a period of about 48 minutes; the whole duration of a flux and a reflux being about 12 hours, 24 minutes, on an average; while the double of this time, or 24 hours, 48 minutes, is the period of a lunar day, that is the time elapsed between any two consecutive passages of the moon over the same meridian. From this observation it is also obvious, that the sea flows both when the moon passes the arch of the meridian above the horizon, and also when she passes the arch below it; and, in like manner, that the sea ebbs both when the moon passes the eastern and the western side of the horizon. It is also observed, that the flow of the tides is somewhat greater when the moon is on the meridian, than when she *is opposite to it*; and that the tides, generally speaking, diminish in their altitude from the equator to the poles.

2d. The second observations respecting the phenomena of the tides, are the following: That the sea flows and ebbs twice every day from the influence of the sun, as well as from that of the moon, as evinced by what takes place when the sun comes to the meridian. The solar tides are, however, much less than the lunar ones, on account of the immense distance of the sun; and, though they are subject to the same laws as the latter, yet their influence is scarcely observable except in particular situations of the moon. Indeed the tides, which depend on the mutual action of the sun and moon, are not distinguished from each other, but are so compounded as to form, as it were, one united tide, increasing to a maximum at one period, and decreasing to a minimum at another, and thus making what are called neap and spring tides; for, by the action of the sun, the lunar tide is so changed as to vary every day, on account of the difference between the natural and the lunar day. In the syzygies, that is, the conjunction and opposition of the sun and moon, the action of both these luminaries conspire, and the sea is more elevated than at any other point of the moon's orbit. The sea, on the other hand, is less elevated at the quadratures, that is, when she is 90° distant from the points of the syzygies; for when the waters are elevated at the former points by the action of the moon, they are depressed by that of the sun. Hence it is observed, that when the moon passes from the syzygy to the quadrature, the daily height of the tide is continually diminished; and, on the contrary, when she passes from the quadrature to the syzygy, it is continually increased. It has likewise

been observed, that at new moon, or conjunction, the height of the tides is greater than at full moon; and also that the differences in the daily increase, or diminution, are greater in the former case than in the latter. The greatest differences in the height of the tides, that is, their maximum or minimum elevation, are not observed till the second or third day after the new or full moon. And, according as the declination of the sun and moon increases, so are the tides in general in some degree diminished.

3d. The third phenomena of the tides now fall to be mentioned. It has been observed, that the tides are greatest at two periods of the year, particularly when the moon is in her syzygies. These periods are when the sun is in or near the equinoxes; both the sun and moon being then at or near the equator. The actions of these bodies upon the tides are also the greater, in proportion as they approach nearer to the earth; and these actions diminish in proportion as they recede from the earth. It has also been observed, that the greatest tides take place near the equinoctial seasons, but not exactly at those periods; for they occur when the sun is a little to the south of the equator; that is, a little before the vernal equinox, in the one case, and a little after the autumnal equinox in the other. This, however, does not occur at a fixed periodical time, because variations arise from the position of the moon's orbit, and the distance of the syzygy from the equinox. Such are the phenomena that take place in the flux and reflux of the ocean, where it is unobstructed by the winding of the shores, the narrowness of straits, and the inland situation of bays, gulfs, and mediterranean seas.

(To be continued.)

RULES FOR THE RECOVERY OF THE APPARENT DROWNED.

At this season of the year, when there are cases occurring, almost daily, of persons being drowned from incautiously venturing to bathe in places where they are unacquainted with the depth of water, we think it may be useful to insert the Rules of the Royal Humane Society for the recovery of the apparent drowned. It is a dangerous opinion to suppose, because animation is apparently suspended, that life is irrecoverably gone. Although there are no instances on the records of the Society, of persons having been recovered who had been more than three quarters of an hour in the water, yet there are numerous instances of persons having been apparently dead for several days who have been restored to life and health; and, notwithstanding the great acquisitions made in medical science at this day, it cannot be said that we have yet obtained an infallible test of death, not even excepting putrefaction; indeed it is better that it is so, as it would be inhuman to give up any person for dead, (whether suffocated by water, hanging, freezing, or syncope,) upon the application of any test, before every remedy had been used and proved ineffectual for their resuscitation.

RULES OF THE ROYAL HUMANE SOCIETY,

For the Recovery of the apparent Drowned.

RESUSCITATION.

What thou doest—do quickly.

1. Convey carefully the body, with the head raised, to the nearest convenient house.

2. Strip and dry the body; clean the mouth and nostrils.

3. Put young children between two persons in a warm bed.

4. An adult. Lay the body on a blanket or bed, in a warm chamber in

winter, to be exposed to the sun in summer.

5. It is to be gently rubbed with flannel sprinkled with spirits, a heated warming pan, covered, lightly moved over the back and spine.

6. To restore breathing—introduce the pipe of a pair of bellows (when no apparatus) into one nostril; the other, with the mouth, closed; inflate the lungs till the breast be a little raised; the mouth and nostrils must then be let free: repeat this process till life appears.

7. Tobacco smoke is to be thrown gently into the fundament, with a proper instrument, or the bowl of a pipe covered, so as to defend the mouth of the assistant.

8. The breast to be fomented with hot spirits, if no signs of life appear, the warm bath, or hot bricks, &c. applied to the palms of the hands, and soles of the feet. Or put the feet in warm water, as hot as the hand will bear it, where a warm bath cannot be had.

The Medical Assistants have always considered *Enema Nicotiana Fumesum*, (throwing tobacco up the fundament,) as an essential part of the process in cases of Suspended Animation.

1. It is the admission of a kindly warmth into the internal parts, which, in all cases, must prove advantageous.

2. Its stimulus, connected with this warmth, seems admirably adapted to excite irritability, and to restore the peristaltic motion of the intestines.

3. Experience and observation have proved that animation being excited in one part, the whole will be often brought into motion, and vital action restored; such is the general sympathy of an animated body.

INTENSE COLD.—Rub the body with snow, ice, or cold water. Restore warmth, &c. by slow degrees, and, after some time, if necessary, use the plans to be employed for the resuscitation of drowned persons.

SUFFOCATION BY NOXIOUS VAPOURS OR LIGHTNING.—Cold water repeatedly thrown upon the face, &c. drying the body at intervals. If the body feels cold, employ gradual warmth, and the plans of the drowned.

GENERAL OBSERVATIONS.—1. On signs of returning life, a tea-spoonful of warm water may be given; and, if swallowing be returned, warm wine or diluted brandy. The restored person to be put into a warm bed; and, if disposed to sleep, he will generally awake in almost his former state of health.

2. The plans above recommended are to be used for three or four hours. It is an absurd and vulgar opinion to suppose persons are irrecoverable because life does not soon make its appearance.

CAUTIONS.—1. Persons who bathe in rivers, canals, or any pool of water, are advised to make every proper inquiry concerning such places as are dangerous; and they are warned not to approach too near them, as a great number of young persons have been drowned through a culpable neglect of this caution, and they have not only lost their lives, but have brought the greatest distress upon their parents and friends.

2. Bathers are cautioned not to go so far from the shore, as to be out of reach of immediate assistance, should they be in danger of drowning; for although the Society has provided drags to extricate them from their distress, yet these cannot be made to reach very far from the shore.

3. In every case of danger, application should be made with the utmost expedition to the nearest Recovery House, and also to the nearest medical assistant.

4. In removing the body, great care must be taken that it be not too roughly handled, nor carried over the shoulders with the *head hanging downwards*, nor *rolled upon the ground*, nor lifted up by the heels, as used to be the absurd and dangerous custom. The unfortunate object should be cautiously conveyed by two or more persons, on some vehicle upon straw, lying as on a bed, with the head *a little raised*, and kept in as easy a position as possible.

MISCELLANIES.

THE SCRAP GATHERER;

OR,

A Selection of Facts worth knowing.

"Science is not Science till revealed."

No. 6.—The Construction of a Steam Engine consists of a large cylinder, or barrel, in which is nicely fitted a solid piston, like that of a forcing pump. The steam is supplied from a large boiler close by, and is admitted into the cylinder by an orifice, which can be occasionally shut. The force of the steam lifts the piston, to the top of

which is affixed a long lever, to work a forcing pump, or for any other purpose; and when the piston is lifted a certain height it opens a small valve in the top of the cylinder, through which a small quantity of cold water being admitted, the steam is condensed, and thus a vacuum being created, the piston again descends, and is again lifted up by the force of the steam.

7.—*The Actual Performance of Steam Engines.*—An engine having a cylinder of 31 inches in diameter, and making 17 double strokes per minute, performs the work of 40 horses working night and day, (for which three relays, or 120 horses, must be kept,) and burns 11,000 pounds of Staffordshire coal per day. A cylinder of 19 inches, making 25 strokes, of 4 feet each, per minute, performs the work of 12 horses, working constantly, and burns 3700 pounds of coal per day. A cylinder of 24 inches, making 22 strokes of 5 feet, burns 5500 pounds of coals, and is equivalent to the work of 20 horses; and so on.

ACOUSTICS.

Influence of Sounds on the Elephant and Lion.—In the human ear the fibres of the circular tympanum radiate from its centre to its circumference, and are of equal length; but Sir E. Home has found, that in the elephant, where the tympanum is oval, they are of different lengths, like the radii from the focus of an ellipse. He considers that the human ear is adapted for musical sounds by the equality of the radii, and he is of opinion that the long fibres in the tympanum of the elephant enable it to hear very minute sounds, which it is known to do. A piano-forte having been sent on purpose to Exeter Change, the higher notes hardly attracted the elephant's notice, but the low ones roused his attention. The effect of the higher notes of the piano-forte upon the great lion at Exeter Change was only to excite his attention, which was very great. He remained silent and motionless. But no sooner were the flat notes sounded, than he sprang up, attempted to break loose, lashed his tail, and seemed so furious and enraged as to frighten the female spectators. This was attended with the deepest yells, which ceased with the music. Sir E. Home has found this inequality of the fibres in neat-cattle, the horse, deer, the hare, and the cat.—*Edin. Phil. Journ.*

SMEATON.

John Smeaton, the celebrated engineer, discovered great strength of understanding and originality of genius at a very early age. His playthings were not the baubles of children, but the tools with which men work; and he appeared to have greater pleasure in seeing the men in the neighbourhood work, and asking them questions, than in any thing else. One day he was seen, to the distress of the family, on the top of his father's barn, fixing up something like a windmill. Another time, he attended some men who were fixing a pump at a neighbouring village; and observing them cut off a piece of bored pipe, he procured it, and actually made with it a working pump that raised water. All this was done while in petticoats, and before he had reached his sixth year.

About his fourteenth or fifteenth year, he had made for himself an engine to turn rose work; and presented several of his friends with boxes of ivory or wood, turned by him in that way. He made a lathe, by which he cut a perpetual screw in brass; a thing little known at that day, and which is supposed to have been the invention of Mr. Henry Hindley of York, a great lover of mechanics, and a man of the most fertile genius. Mr. Smeaton soon became acquainted with him; and they frequently spent whole nights together, conversing on such subjects until daylight.

Mr. Smeaton had thus, by the strength of his genius and indefatigable industry, acquired, at the age of eighteen, an extensive set of tools, and the art of working in most of the mechanical trades, without the assistance of any master. Of his talents as an engineer, in after life, the Eddystone Light-house will, we trust, long remain a splendid monument.—*Percy Anecdotes.*

Chemistry a Corrective of Pride.

We know that Religion has, on many occasions, been a corrective of pride; but never till we perused the following amusing anecdote did we imagine that the abstract science of chemistry might be applied to that moral purpose.

"In Germany the taste for chemistry extends as rapidly as liberal ideas. The following anecdote proves the truth of this observation. A nobleman of a very ancient family, received lessons at Berlin from the celebrated Professor Klaproth,

whose recent death has proved so great a loss to the sciences. One day as he was proceeding to the laboratory of the Philosopher, his carriage overturned, and he and his coachman were so severely bruised that they were under the necessity of being bled. The noble German immediately conceived the idea of profiting by this accident, to discover whether the blood of a gentleman differed in any way from that of a common person. He sent the produce of the two bleedings, in separate vessels, to Klaproth, and requested him to make a comparative analysis of them. The skilful chemist, after the most scrupulous attention, found that each contained the same quantity of iron, lime, magnesia, phosphate of lime, albumen, muriate of potash, and soda, sub-carbonate of soda, sulphate of potash, extractive mucous matter, and water. The quantity of water was two hundredth parts greater in the blood of the nobleman than in that of his coachman. This might have been an advantage to the latter, had so slight a difference been worthy consideration. It may, therefore, be presumed, that the blood of a nobleman and that of a plebeian are physically and chemically identical. The nobleman, who was delighted with this result, transmitted a copy of the analysis to his son's tutor, in order that the young man might be reminded of it whenever he affected to believe that his blood was purer than that of other men.

ROAD MAKING.

Doubts have been entertained of the expediency of Mr. M'Adam's new system of road making as far as regards towns, from the great annoyance felt by the quantity of dust thrown up in those places where the experiment has been tried. A discovery, however, has just been made by Mr. Gilmore, the surveyor of the turnpike road between Durham and Tyne Bridge, which we think will remove every inconvenience felt from the dust, and be an important improvement on Mr. M'Adam's plan. This discovery consists in the application of a portion of the oil of salt, which has not only had the effect of completely laying the dust, but it has operated also as a cement, making the pavement, at once, firm and smooth. Mr. G. has tried his discovery on a part of the turnpike road near Bittley, when the experiment succeeded to the extent of his wishes. In the course of the last week he applied a quantity of the oil of salt to that part of Dean-Street, which is the only part of Newcastle which has yet been M'Adamized, and the effect has been such as we have described. The dust has been laid much more effectually than it had previously been by water. It appears, therefore, from these experiments, that the plan is equally applicable to streets and turnpike roads, and it seems to be a discovery which entitles Mr. Gilmore to the patronage of the public.

NEW METHOD OF PAVING STREETS.

A Patent has been granted to A. H. Chambers, Esq., of Bond-Street, for a method of constructing paved carriage-ways, possessing the advantages of great durability, cleanliness, and uniformity of surface. The means employed for the attainment of these objects are as follow:—A bed of well-compressed clay, with a channel for carrying off water on each side, is first laid down; upon this is spread a thin stratum of sand, which supports the ordinary granite paving-stones, care being taken to select them of equal height, and to place them not in the usual way, but with their broad ends downward: the interstices are filled with hard materials, and the whole is covered with a burned and vitrified substance, which is incapable of being reduced, by moisture or friction, into a soluble matter. The object of this arrangement is obviously to give solidity, by keeping the direction of all superincumbent weight within the base of every separate part of the pavement, and to prevent the rising of earthy matter from beneath, or the lodging of water on the surface. An experiment of the efficacy of the invention is about to be made in Harcourt-Street, Mary-le-bone; and as it involves but little additional expense, it is understood that upon its succeeding depends the general adoption of the plan in all the great thoroughfares in the metropolis.—*New Monthly Mag.*

TYPHUS FEVER.

Dr. J. Bingham, of Leixlip, has published in the Irish papers the following, as a successful mode of treating the malignant fever now so prevalent in that country. He observes, that his own ex-

ence of its efficacy enables him to nulgate it with confidence. The re- y, in fact, consists in the exhibition nustard:—

From the favourable effect," ob- es Dr. B. "I have invariably found produce on the patient, I place a t reliance on it, especially when ad- istered in the early stage of the com- it, by giving the patient, if an adult, -spoonful, or two drachms of com- mustard, mixed in a tumbler of te- water, which, in less than half an , will produce a gentle, free, and ary vomiting, merely disburthening tomach of its contents; and, during peration, I give the patient about a t of tepid water, as used in the or- ry vomits. Immediately on the ard being taken into the stomach, it uces a glow of warmth which per- the entire system, together with a lar sensation, scarcely to be de- ed, unless by the patients who have it, that soon changes the skin from hot, dry, and uncomfortable feel, ys to be met in incipient fever, into t, moist, and cool state, which is eded by a gentle perspiration, and e-establishment of the functions of digestive organs. In about eight after the stomach has been emptied e above manner, I give the patient, ll grown, four grains of calomel; in the course of two hours after the nistering of the calomel, I give a e saline purgative. With this prompt nent, I have, in the majority of where the patients made application during the first two or three days eir complaining, rescued them from plaint setting in with all its ma- nt features; and, in the few in- es in which I have not suppressed idemic in this way, I have found, y having recourse to mustard, with auxiliaries, in the future stages of mplaint, I have been enabled, al- invariably, to announce the certain ery of the patient."

Corrosion of the Coppering of Ships. a meeting of the Royal Society, on 2d January, Sir Humphrey Davy paper on the cause of the decay rrosion of the coppering of ships, he ascribed to a constant, though chemical action of the saline parts surface of the copper. This action *iders as galvanic*; and it is known that some copper suffers comparatively little corrosion to that which takes place where the copper contains a small quantity of zinc or any other metal. In order to remedy this great practical evil, Sir Humphrey Davy has shown, that if a very small surface of tin is brought into contact with a surface of copper 100 times its size, it will render the copper so negatively electrical that the sea-water is no longer able to corrode it. The same effect was produced when a small piece of tin was made to communicate with a large surface of copper by means of a wire. We are informed by a friend (who saw the result of the experiment) that with a piece of Mr. Mushet's patent copper, a piece of common copper, and a piece of the one rendered negatively electrical by zinc, and subjected to the action of salt-water, the common copper was highly corroded, and the patent copper less so, while the negatively electrical copper was not affected at all. This elegant invention of Sir Humphrey Davy, will, we doubt not, be well appreciated by the government and the public.—*Edin. Phil. Jour.*

PATENTS LATELY GRANTED.

(Continued from page 240.)

To John Arrowsmith, of Air-Street, Piccadilly, in the County of Middlesex, Esq. in consequence of discoveries by himself, and communications made to him by certain foreigners residing abroad, for an improved mode of publicly exhibiting Pictures, or Painted Scenery, of every description, and for distributing or directing the day-light upon, or through them, so as to produce many beautiful effects of light and shade, which he denominates Diorama.—10th Feb. 1824.

To Augustus Applegarth, of Duke-Street, Stamford-Street, Blackfriars, in the County of Surrey, Printer, for his invention of certain improvements in machines for Printing.—19th Feb. 1824.

To John Vallance, of Brighton, in the County of Sussex, Esq. for his new invented method of communication, or means of intercourse, by which persons may be conveyed, goods transported, or intelligence communicated from one place to another with greater expedition than by means of Steam Carriages, Steam or other Vessels, or Carriages drawn by animals.—19th Feb. 1824.

To A. H. Chambers, of New Bond-Street; for improvements in preparing

and paving horse and carriage-ways. Feb. 28, 1824.

To R. Evans, of Bread-Street, Cheapside; for a method of roasting or preparing coffee and other vegetable substances, with improvements in the machinery employed, such process and machinery being likewise applicable to the drying, distillation, and decomposition of other mineral, vegetable, and animal substances, together with a method of examining and regulating the process whilst such substances are exposed to the operations before-mentioned. Feb. 28, 1824.

To J. Gunby, of New Kent Road, Surrey; for a process by which a certain material is prepared and rendered a suitable substitute for leather. Feb. 28, 1824.

To C. Demeny of Paris, but now residing in London, for an apparatus, containing within itself the means of producing gas from oil and other oleaginous substances, of burning such gas, for the purpose of affording light, and of replacing the gas consumed. Communicated to him by a certain foreigner residing abroad.—March 22, 1824.

To N. Goodsel, late of New York, but now of Buxton-Crescent, for a machine, or piece of machinery, for breaking, scutching, and preparing flax and hemp for use, upon an improved method, and threshing out the seed thereof; and which is applicable to the threshing of any other kind of grain; and also for shelling clover and other seeds.—March 25, 1824.

To J. Spencer of Belper, for improvements in the construction of furnaces, or forges, for the preparation of iron or steel; and for the process of manufacturing of nails, and other articles from the said materials.—April 7, 1824.

To J. Schofield of Rustrick, Yorkshire, for improvements in the manufacture of cloth, or fabric, which he denominates British Cashmere.—April 7, 1824.

To T. Ryalls, of Sheffield, for an apparatus for shaving; which he denominates—The Useful and Elegant Facilitator.—April 8, 1824.

To S. Hall, of Basford, for an improved Steam Engine.—April 8, 1824.

To J. Tulloch, of Savage-Garden, London, for improvements in the machinery to be employed for sawing and grooving marble and other stone, or in producing grooves and mouldings thereon.—April 12, 1824.

To H. P. Burt, of Devizes, for an improvement in the construction of cranks, such as are used for bells and other purposes.—April 14, 1824.

To W. By, of Brighton, for a method, or apparatus, for the protection of books and covers.—April 14, 1824.

To J. Gunby, of New Kent road, Surrey, for an improvement in the process of manufacturing cases for knives, scissors, and other articles.—April 14, 1824.

To D. Gordon of Basinghall-Street, for improvements in the construction of portable gas lamps.—April 14, 1824.

To J. Burns, of Manchester, for a new apparatus for dressing various kinds of cotton flax, or woollen or silk manufactures.—April 14, 1824.

(To be continued.)

NOTICES TO CORRESPONDENTS.

S. Y. will appear in our next; his proposed communication will be acceptable.—To B. Z. we must apologise, and solicit his further indulgence.—Although we agree with G. B. that the common method of calculating interest is as easy, and not so complicated as the one proposed by W. C.; yet we are acquainted with an easier and simpler method than either, which shall be inserted in our next.

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J. CURLL, PRINTER.

THE GLASGOW

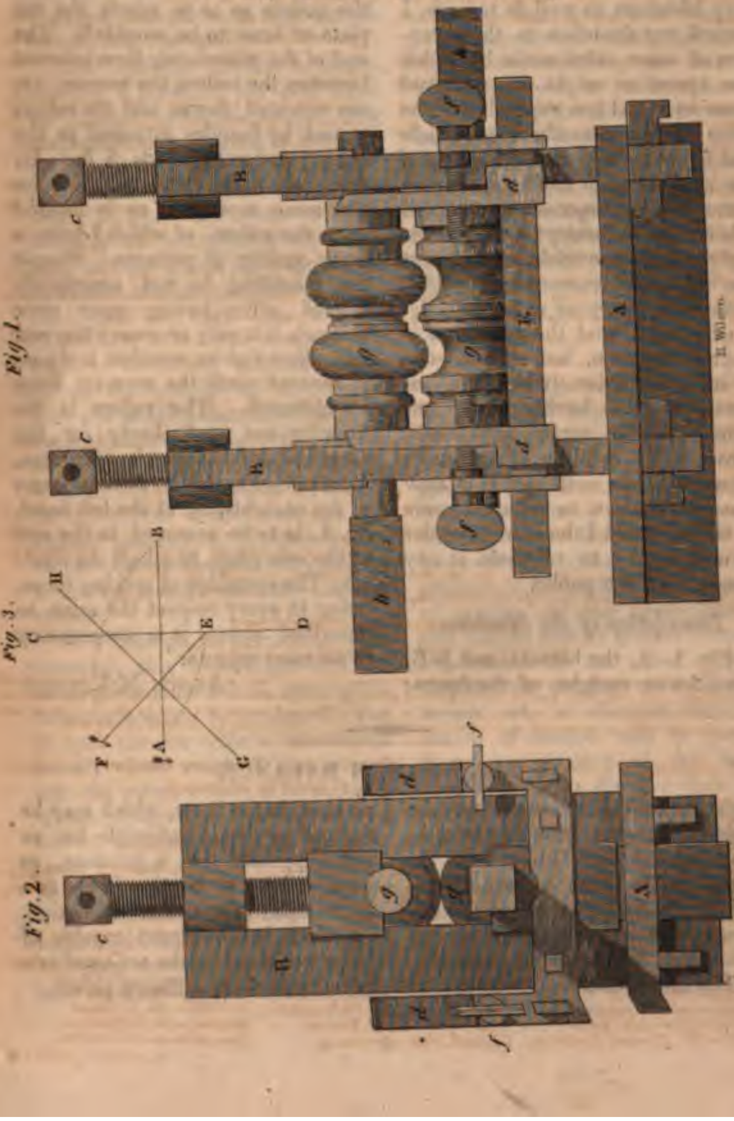
MECHANICS' MAGAZINE.

"Ye shall do no unrighteousness in judgment, in mete-yard, in weight, or in measure. Just balances, just weights, a just ephah, and a just hin, shall ye have."—*Levit.* xix. 35, 36.

No. XXV. *Saturday*, 19*th June*, 1824. Price 3*d*.

ROLLING MACHINE,

Invented by Mr. Angus M'Kinnon, Glasgow.



ROLLING MACHINE,

For making the Brass Mouldings in Fenders, and in the Brass Work of Grates.

Invented by Mr. Angus M'Kinnon, Glasgow.

The invention of this machine originated in a cause, which has since operated in producing many others, namely, the reduction of prices at the Peace. The usual mode of raising the brass mouldings previous to that period, was by hammering and cressing, which, being very laborious as well as tedious, I turned my attention to the invention of some other mode by which the operation might be rendered more easy and less expensive. The price of the manufactured article had fallen so low, and the wages of the workmen not having suffered a corresponding depression, rendered this almost necessary; and, accordingly, after some trials, the present machine was constructed, which answers the purpose most perfectly. I may state, that the invention is entirely my own, but a knowledge of its construction, (which is abundantly simple,) having been communicated to some individuals, through the medium of workmen who had been with me, it is now generally known to manufacturers in the line, and I therefore consider it unnecessary to withhold it any longer from the public.

Description of the Machine.

Fig. 1. A, the bottom, and B B, the sides or uprights of the frame; *g g*, two moveable rollers, and *d d*, guides, of which there are two on each side of the rollers, see fig. 2.

When the machine is to be used, it is placed on an iron stand, two feet and a half high, and fastened to the floor. The screws, *c c*, are then screwed upwards, to separate the rollers so as to admit the flat plate of brass to be moulded. The end of the plate being then inserted between the rollers, the screws, *c c*, are screwed down, and the rollers turned by handles attached to the square projecting ends *h h*. By this motion the brass will acquire the same moulding as is formed upon the rollers, of which I have a great variety of patterns. Should the moulding be not completely formed after having gone once through, it is only necessary to screw the rollers tighter together, and pass it through until the accurate form be obtained. The rollers in the drawing are used chiefly for the ornamental brass work of grates. When fenders are to be made, one of the uprights, B, at the left hand, fig. 1, is to be removed to the end of the sole plate, to admit the fenders. The operation of making these, being in every respect the same as described above, it is unnecessary to be more minute.

Angus M'Kinnon.

ON THE COMMON BALANCE.

The requisites necessary for the most accurate construction of a common balance are founded on the consideration of the Theory of Momenta, in the doctrine of parallel forces, and its application to the mechanical powers, or instruments.

The first of these instruments, or powers, is the lever, which may be defined to be an inflexible bar or rod supported on a fulcrum, or prop, moving or turning freely at a point called the centre of motion, by which it is rendered capable of being subjected to the action of two or more forces at different points.

. These forces, from the manner in which they are applied, are respectively denominated the power or the weight. Hence the lever has been distinguished into three different kinds, according to the relative positions of the power, the weight, and the fulcrum, or prop. In the first kind, the fulcrum is between the power and the weight; in the second, the weight is between the prop and the power; and, in the third, the power is between the weight and the prop.

The common balance is consequently a lever of the first kind, and consists of a beam conveniently suspended or supported in the middle, having two equal scales suspended at its extremities. The beam is generally made to taper towards the extremities on either side of the point of support, or centre of motion; and the parts of the beam on each side of this centre are called the *arms* of the balance, and their extremities are called the points of suspension. The use of the common balance, as formerly hinted, is to obtain an accurate knowledge of the unknown weights of any substances, by means of substances whose weights are exactly known; or, in other words, to produce an equilibrium between a known weight and any mass of matter.

If a balance be accurately constructed, this knowledge will be easily obtained, that is, the equilibrium can easily be produced. For if, into the one scale is introduced a body whose weight is known, and into the other, a body is introduced whose weight we are anxious to know; then, according as the latter scale is above, in the same horizontal line with, or below the former scale, so will the weight of the latter body be greater, equal to, or less than the weight of the former body. The equilibrium, or non-equilibrium, however, is more correctly ascertained by observing the horizontal or oblique position of the beam, which is indicated by a wire perpendicular to the beam, and which oscillates on each side of the line of support.

When the beam takes the horizontal position in any given circumstances, then the balance being supposed accurate, it is said to be in equilibrio.

Now, that a balance may be fairly constructed and rendered accurate, the following are essential requirements in its construction:

1st, That the arms be equal to each other in length.

2d, That the points of suspension be in the same straight line with the centre of motion.

3d, That the centre of motion coincide as nearly as possible with the centre of gravity.

4th, That the friction be as little as possible.

I. That the arms be equal to each other in length; that is, that the points of suspension in each be equi-distant from the centre of motion. When the arms are unequal, it is evident that if equal weights be put into the scales, that scale will preponderate whose point of suspension is farthest from the centre of motion, for the momentum of this weight will be greater than the momentum of the other weight; that is, the product of the former weight into its distance from the centre of motion will be greater than the product of the latter weight into *its* distance from the same centre. Hence it will require a greater weight to be put into that scale, whose point of suspension is nearest the centre of motion, in order to produce an equilibrium. We shall illustrate this by an example. Suppose that the left arm of a deceitful balance is 12 inches

long, and the right arm is 16 inches long, that a weight of 2 lbs. or 32 ozs. is put into the left scale, and it is required to find what weight must be put into the other scale to balance it; and here it is obvious, that the scales and arms being supposed of equal weight, they do not enter into our calculation; for, being equal and contrary, their effect is nullified. Now, since the weights must be reciprocally proportional to the lengths of the arms at which they are respectively suspended, we shall have, in this case,

$$\overset{\text{in.}}{16} : \overset{\text{in.}}{12} : : \overset{\text{oz.}}{32} : \overset{\text{oz.}}{24}$$

the required weight. Or, by dividing the momentum of the given weight, by the length of the arm at which the required weight is to be suspended, the quotient will give the required weight; that is, $\frac{32 \times 12}{16} = 24$ ounces, as before. Hence it is obvious, that if I am inattentive to this fact, when purchasing any article, a dishonest tradesman may impose upon me, to a very considerable extent, by means of a balance whose arms are of unequal length. But if I, on the other hand, be on the alert, it is in my power to inflict a proper punishment on him for his deceitful intentions, by turning against himself his own "wicked balance." Suppose, for example, I am commissioned by a friend, who resides in the country, to purchase for him 2 lbs., that is, 32 ozs. of tea;—a shop-keeper has a balance of the above description; I go to his shop; I want 2 lbs. of tea; well, he puts a weight of 32 ozs. into the left scale, and into the right he puts as much tea as produces an equilibrium; "That is the weight, Sir; shall I wrap it up, and send it home?" "By all means; but, first put the tea into the left scale, and your weight into *the right one.*" This he cannot refuse; but, knowing that they will not now balance each other, and that there will be a deficiency in the left scale of $18\frac{2}{3}$ oz., he foresees the consequence, and trembles for his credit; I, however, step to the door for a moment, and thus give him an opportunity to avoid open disgrace; this opportunity he greedily embraces; and the result is, that I leave his shop with $10\frac{2}{3}$ ozs. more than I should have, and with $18\frac{2}{3}$ ozs. of tea more than I would otherwise have had for the same sum of money. For $\frac{32 \times 16}{12} = 42\frac{2}{3}$ ozs. and $42\frac{2}{3} - 32 = 10\frac{2}{3}$, and $42\frac{2}{3} - 24 = 18\frac{2}{3}$. This case furnishes us with two queries, which we shall leave the moralist to solve. 1st, Whether I ought to make the fraud, just now attempted to be practised on me, known to the public? and, 2d, Whether I ought to send all the tea to my friend in the country, or only the nett weight?

It is obvious, from this case, that, supposing, as we did at first, that the weights of the arms and scales were equal, an equilibrium will not take place, as might be supposed by a superficial observer; and that, in order to the above results taking place, the weights of the scales must be reciprocally proportional to the lengths of the arms at which they are suspended. In fact, if, in addition to the first supposition, the weight of each of the scales were considered as 32 ozs., the result would be, that a double fraud would be practised, and I would only receive the one half of what was my due, that is, 16 ozs. instead of 32. For $\frac{64 \times 12}{16} = 48$, and $48 - 32 = 16$.

Corollary.—The real weight of any substance may be obtained even from a deceitful balance. For, suppose a balance, as before, having

arms of unequal lengths, and scales whose weights are reciprocally proportional to their lengths, and let a substance when put into the left scale weigh 24 ozs., and when put into the right one $42\frac{2}{3}$ ozs.; then, let

$l =$ the length of the left arm,
$r =$ " " " " right arm,
$w =$ " unknown real weight.

From the foregoing considerations, we shall have the following equations:

$$24\ l = w\ r$$
$$42\tfrac{2}{3}\ r = w\ l$$

$1024\ l\ r = w^2\ l\ r$, by multiplication, and by division and extraction:

$w = \sqrt{1024} = 32$ ozs. the real weight. Hence the real weight is a geometrical mean between the two false weights shown by the deceitful balance.

II. The points of suspension must be in the same straight line with the centre of motion. If the centre of motion be either above or below the points of suspension, the arms of the beam will resemble the two sides of an isosceles triangle, in the one case standing on its base, in the other, inverted. Now, the reasoning employed in the preceding chapter, will apply to this from the following consideration: That the momentum must always be estimated by the perpendiculars drawn from the centre of motion, to the vertical lines that pass through the points of suspension. When the points of suspension are below the centre of motion, the centre of gravity will also be below it, and consequently the balance will be moved with difficulty, from the nature of the action of gravity, whence it has been called the "dour" balance.

When the points of suspension are *above the centre of motion*, the centre of gravity will likewise be above it; hence the balance, resembling an inverted pyramid, or cone, will be too easily moved, on which account, it has been called the "coup" balance. Now, when a weight is put into the one scale of a "dour" balance, it will require a less weight in the other scale to bring to a seeming equilibrium, and consequently the weight of any substance cannot be correctly ascertained by a balance of this kind. The reason of this is obvious; for, by the descent of the one scale, its momentum is diminished; while, by the ascent of the other, its momentum is increased; because the point of suspension in the one arm approaches the centre of motion, while that point in the other recedes from it, and consequently the perpendiculars by which the momenta are estimated are shortened or lengthened in the same proportion.

On the other hand, if a weight be put into the right scale of a "coup" balance, it will require a greater weight in the left one to bring it to an equilibrium. For, by the descent of the right scale, its momentum is increased, while that of the other is diminished by its ascent; because the point of suspension of the right scale recedes from the centre of motion, while that of the left approaches it.

In short, if we suppose the right arm of such a balance to take the position of a perpendicular, drawn from the centre of motion to the vertical line passing through the point of suspension, then the left arm will take the position of a hypothenuse to the perpendicular and vertical, on the left side of the balance, forming a right angled triangle; and consequently, the momentum of the left scale will be less, in proportion as the perpendicular is less than the hypothenuse, or left arm; which perpendicular

will be less or greater, according to the difference between the angle formed by the two arms and two right angles.

Hence we see, that imposition may be practised, by either of these balances, to as great extent as in the former case. For, a small quantity may be balanced by a greater weight in either balance, according as the quantity is put in the one scale before or after the weight is put into the other. Thus an expert shop-keeper, while he apparently gives more than he ought, by making the "scale fly up and kick the beam," may put into extensive operation a system of deceit; and, while he is defrauding his customers of their due, "giving them the scant measure, which is abominable," his trade may be daily increasing, and the poor of his neighbourhood may enroll him in the number of those, who are sure of a blessing, because they "give good measure, well pressed, and running over."

III. The centre of gravity must coincide, as near as possible, with the centre of motion. If the centre of motion be placed in the centre of gravity of the beam, and in the line with the point of suspension, the beam will remain in any position in which it may be placed, whether loaded or unloaded with equal weights. Of a beam of this description, the weight of the whole is equal to the weight which is at the point called the centre of gravity: when, therefore, this point is sufficiently sustained by any opposing forces, it follows, that the whole beam is kept in equilibrio, and is so kept in an inclined as well as in a horizontal position. But, by a beam of this kind, the object of the balance cannot be obtained. For experience attests, that a nice and accurate knowledge of the respective *weights of two* nearly equi-ponderant *bodies* can be procured from that beam alone, whose tendency is to equi-librate in the horizontal position. The centre of gravity of the beam, therefore, must be placed a little below the centre of motion, and the less the distance between the two centres is, the more accurate will the balance be. For if the centre of gravity be above the centre of motion, the beam will be overset by the smallest action, that is, the arm which is moved by any application however slight, will sink as far as it can; for, by the motion, the centre of gravity is continually descending, according to its nature. But the object of the balance cannot be fully attained by a beam of this description; for, since by surrounding bodies in motion, particles and even parts of them are elicited and driven about in all directions; since, moreover, currents of air are continually shifting their positions, and each and all of these coming in contact with either end of the beam, it must necessarily be rendered inadequate, in common usage, for giving an accurate knowledge of the comparative weights of bodies. The beam will always be tending to assume an inclined position, and this will indicate an inequality between two bodies, which, in weight, may be exactly alike. Again: If the centre of gravity be much below the centre of motion, the beam will continue always in motion, until it be forcibly brought into a level position. If one end of the beam be depressed a little to destroy the equilibrium, it will return back and vibrate up and down; for, by the motion, the centre of gravity is endeavouring to descend. Hence the same observations that were made above, apply here also. But, lastly: If the centre of gravity be immediately under that of motion, then from all the foregoing observations, it is evident, that this balance will be the most

accurate; for whatever declination either arm of the beam may receive, the beam itself will, after a few vibrations, resume the horizontal position. It is of peculiar importance, then, to affix the centre of motion; for the nearer the centre of gravity is brought up to that of motion, without altogether coinciding, the more delicate the balance will be: it will be cast with more facility, and it will more readily return to the horizontal position.

IV. There must be as little friction as possible. And the reason is, that, should the friction be great, it will require a considerable force to overcome it; upon which account, though one weight should a little exceed the other, the greater will not preponderate; for the excess of weight will not be sufficient to overcome the friction, and bear down the beam. If the friction then were unavoidably great, we would find it an impossibility to construct a delicate and accurate balance. But the inconvenience arising from friction may be very much obviated. The friction cannot be entirely destroyed, but it may be reduced to almost nothing. If the arms of the beam be made as long as they conveniently can, their weight will be but little affected by the friction; and as the momentum increases in proportion to the distance from the centre of motion; the longer the arms are, the less will the weight be that is requisite to overcome the friction. But the friction will be most effectually obviated by making the axis of motion a very sharp prismatic edge, and by supporting this axis on a socket of highly tempered steel, in order that the axis may turn about with facility. If these and other similar precautions be adopted in the fabrication of accurate balances, the friction will be so much diminished as, at all events, to bear a very trifling proportion to the whole weight employed, and to have no sensible effect in disturbing the equilibrium.

ON THE LAWS OF KEPLER.

(Continued from page 373.)

The important discovery of the second law led to a third, the most astonishing of them all. He suspected that some analogy existed between the times of the revolutions of the planets and the dimensions of their orbits; and this he undertook to ascertain. Hence arose new calculations, the great extent of which may be imagined, when we consider that Kepler was groping his way, as it were, in the dark; but he was guided by genius, as persevering and laborious as it was poetical and fanciful, and he ultimately succeeded in his researches. He observed that the superior planets not only revolved in greater orbits, but also with less velocity than that of the inferior planets; hence, on these two accounts, the times of their periodic revolutions were greater. To illustrate this by an example, Jupiter revolves in an orbit whose mean distance is 5½ times greater than that of the earth from the sun; now, as the Earth revolves in one year, so, if their velocities were equal, Jupiter ought in 5½ years; but the periodic time of this planet is nearly 12 years. The periodic times of the planets increase, therefore, in a greater proportion than their distances from the sun; but not in so great a proportion as the squares of these distances; for if that were the law of their motions, the periodic time of

Jupiter ought to be rather more than 27 years, because the square of $5\frac{1}{4} = 27$ nearly. A mean proportional, however, between the real distances, and the squares of these distances, gives the real proportion of the periodic times; that is, the mean proportional between $5\frac{1}{4}$ and 27 gives the periodic time of Jupiter, *viz.* 12 years nearly.

Kepler having discovered this analogy after numerous trials, was so overjoyed that he wrote down the precise day, (May 15th, 1618,) when he found out this third law of the planetary motions, *viz.*—"That the squares of the periodic times, are as the cubes of their mean distances from the sun." Having discovered these three laws of the planetary motions, he also endeavoured to account for the variation in the velocities of the planets, when at different points of their orbits. He observed that the planets moved with greatest velocity when in perihelion, or nearest the sun; and with least velocity when in aphelion, or farthest from it; but, in accounting for this phenomenon, he was not equally successful.

He supposed that two forces existed in the sun, the one attractive, and the other repulsive; by the former of which, he accounted for the acceleration of the planet, when approaching its perihelion; and by the latter, for its retardation when approaching its aphelion. He seems, however, not to have been satisfied with his own explanation of this phenomenon, and, in the following prophetic terms, expresses his conviction that this would be more fully brought to light: "Hæc et cetera hujusmodi latent in pandectis ævi sequentis, non antea discenda quam librum hunc Deus arbiter seculorum recluserit mortalibus." We know this prophecy received its *fulfilment* in the discovery of universal gravitation by Sir Isaac Newton.

The laws of Kepler furnish rules for computing the orbits of the planets, the eccentricity of each, the differences between the major and the minor axes of the ellipses in which they revolve, the velocity at any point in their orbits, the exact part of the orbit described by each in a given portion of its time of periodic revolution, and their greatest, least, and mean distances from the sun. These laws also extend to the satellites of each planet, and furnish, in like manner, rules for the computation of their orbits.

When we consider the nature of the discoveries of Kepler, as being elevated far above the observation of ordinary men—when we reflect on the deep enthusiasm that dwelt in his bosom, even from his youth, on subjects so far removed from those which commonly interest the human race—and, above all, when we contemplate that unwearied and unremitting perseverance which carried him through the most lengthened and perplexing calculations, we must sit down with the humblest respect, and with the profoundest admiration, of such a brilliant and indefatigable genius. And much more of the discovery of the Keplerean laws than of the discovery of the Copernican system, may it be said, "That it is wonderful they were so soon discovered." Yes; and had it not been for the eccentric genius of a Kepler, ages might have rolled, and Newtons might have risen, ere the fancy that led, and the industry that guided to the discovery of these three laws, simple though they be, had shone forth like a guiding star to the temple of science, and enabled the feeble mind of man to obtain such a victory, and the historian to hang within her walls such a splendid trophy to its fame.

ON THE TIDES.

(Continued from page 379.)

We now proceed to explain the causes of the phenomena of the tides. The simple cause of all these phenomena is the same law that pervades the universe, and preserves the planets in their orbits, *viz.* the attraction of gravitation. It is an obvious and demonstrable fact, that if one body attract another, that those parts of the body attracted which are nearer the attracting body, are more strongly attracted than the more distant. This truth will be the more readily admitted, if the body attracted be surrounded by a fluid mass, while the interior nucleus or kernel consists of a denser and solid mass, of which several parts appear in different places rising above the fluid, indicating not only that the greater part of the exterior surface of the body is really fluid, but that formerly even the whole nucleus was covered with that fluid. Such is the case with the earth and the seas which surround it, which, being attracted by the moon, are subjected to the general law of gravity, and produce the phenomena that have been observed. Those parts of the water are most attracted which are nearest the moon, and those are least attracted which are farthest from her; while those that remain at a mean distance are attracted by a corresponding mean force. Hence the fluid mass assumes an elongated or spheroidal form. And since all the particles of the earth gravitate towards its centre, and since this gravitation far exceeds the attraction of the moon from the proximity of the particles, the effects resulting from the moon's action on the earth will be only a small diminution of the gravity of those particles which are nearest the moon, and which, by its attraction, it endeavours to separate from the centre. In like manner those parts that are farthest from the moon, as well as those which are nearest, will have their gravity towards the centre of the earth somewhat abated. Hence, supposing the earth to be fluid, the columns from the centre to the nearest and to the most distant parts, will rise, till by their greater height they balance the other columns, whose gravity is less altered by the moon's action. And, as the same thing will take place on the supposition of the earth being surrounded by a fluid, it is evident that it must assume the figure of an oblong spheroid. From this it appears that the parts of the earth directly under the moon, and also the opposite parts, will have the flood or high water at the same time; while the parts at 90° distance, or where the moon appears in the horizon, will have the ebb or lowest water at that time. Hence, as the earth turns round on its axis from the moon to the same body again in 24 hours 48 minutes, this oval of water that surrounds the earth must shift with it, and thus there will be two tides of flood and two of ebb in that time. It is evident also, that by the motion of the earth on its axis, the most elevated part of the water will be carried beyond that point which is opposite the moon, in the direction of the rotation. Hence the water will continue to rise after it has passed directly under the moon, though the greatest action of the moon begins to decrease; hence the water does not reach its greatest elevation till it has advanced nearly half a quadrant beyond the point where the moon is on the meridian. The greatest elevation of the waters, therefore, is not in the line which passes through the centres of the

earth and the moon, nor the greatest depression where the moon appears in the horizon, but about half a quadrant eastward from those points in the direction of the rotatory motion. Hence the time of high water is not precisely at the time of the moon's coming to the meridian, but some time after; and the same result takes place with respect to low water, and the moon's appearance in the horizon. In this way are the causes of the first phenomena of the tides explained.

The tides, however, do not always correspond to the same distance of the moon from the meridian at the same place, but are variously affected by the action of the sun, which causes them to take place sooner, when the moon is in her first and third quarters, and later, when she is in her second and fourth; because, in the former case, the tide raised by the sun alone, would be earlier than the tide raised by the moon, and, in the latter case, the reverse would take place.

The effect, however, of the sun in producing the tides, must be considerably less than that of the moon, on account of his immense distance, although the attraction to the sun be much greater, and that distance being so great, the diameter of the earth becomes but a point in comparison with it; hence the difference between the action of the sun on the nearest and on the farthest parts of the earth, become vastly less than if that action took place at the distance of the moon. Nevertheless, the immense magnitude of the sun makes the effect still sensible, even at so great a distance; and, therefore, though the action of the moon has the greatest share in producing the tides, the action of the sun adds sensibly to it when they conspire, as in the full and new moon, when *they are nearly* in the same line with *the centre of* the earth, and therefore unite their forces. Hence, in the syzygies, or at full moon and change, the tides are the greatest, being what are called the Spring-Tides. But the action of the sun diminishes the effect of the moon's action in the quadratures, because the one raises the waters in one place, while the other depresses them in another; hence, the tides are the least in the quadratures, and are called Neap-Tides. It may also be observed, that the spring-tides do not happen precisely at new and full moon, nor the neap-tides at the quarters, but a day or two after; because, as was explained above, the effect is not the greatest, or least, when the immediate action of the cause is the greatest or least, in consequence of the motion of the earth on her axis. The variation in the distance of the moon from the earth produces a sensible alteration in the tides. Since the moon describes an ellipse round the earth, it is evident, that at her nearest distance, she will produce a tide sensibly greater than at her maximum distance from the earth; hence it is, that two great spring-tides never succeed each other immediately; for if the moon be at her least distance from the earth at the change, she must be at her greatest distance at the fall, having made half a revolution in the intervening time, and consequently the spring-tide then will be considerably less than that which took place at the change immediately preceding; and for the same reason, if a great spring-tide occur at the time of full moon, the tide at the following change will be less. Thus have we accounted for the second phenomena of the tides.

The spring-tides are highest, and the neap-tides are lowest, about the time of the equinoxes in March and September; and, on the contrary, the spring-tides are lowest, and the neap-tides are the highest, at the

solstices in June and December; the difference between the spring and neap-tides being much more considerable about the equinoctial than the solstitial seasons of the year. It is obvious, that if the sun or moon were in the pole, no changes would take place in the water; in other words, there would be no tides; because the attraction of these bodies would raise all the water at the equator, or any parallel, to a uniform height all round. On the other hand, when the sun or moon are in the equinoctial, their effect in producing tides must be the greatest; for then the axis of the spheroidal figure which the waters now assume in consequence of their action, which is at that time the greatest, moves in the greatest circle. Hence the spring-tides are the greatest when both these luminaries are in the equinoctial, and the neap-tides the least; and in proportion as they leave the equinoctial and approach the pole, the tides are smaller.

The highest spring-tides occur a little after the autumnal, and before the vernal equinox, because the sun is nearer the earth at those periods. Since the greatest of the two tides which occur every day, is that in which the moon is nearest the zenith or nadir; when the sun is in the northern signs, the greater of the two diurnal tides in our climates is that which takes place when the moon is above the horizon; and when the sun is in the southern signs, the greatest is that which takes place, when she is below the horizon. Hence we find that the evening tides in summer exceed the morning tides; and the morning tides in winter exceed the evening tides. Such would be the phenomena of the tides, if the earth were equally covered with the sea of the same depth, so that the water might freely be allowed to follow the attraction of the moon; but on account of the obstructions which the waters meet in their passage during the propagation of the tides, many diversities arise in the effect, according to the circumstances and situation of the places. Thus have we accounted for the annual phenomena.

ON THE POWER OF THE RUDDER IN STEAM VESSELS.

SIR,—Having had my attention lately turned to the comparative power of rudders over vessels propelled by steam and common sailing craft, I should be glad if any of your numerous Correspondents would support me in my argument, if I am in the right, or correct me if in the wrong.

Some of the Captains with whom I have conversed on the subject, say, that a steam vessel will *not* require more sea room than a sailing vessel to put about. I rather think they are in the wrong; but this is not the subject of dispute. If they do, what is the reason of it? I attribute it to a counteraction opposed by the paddle (to the action of the rudder) on the side to which the vessel is to be turned, and to a loss of power sustained by the paddle on the side turned from, or to use the technical terms, if you steer to the starboard, the starboard paddle opposes the action of the rudder, and the larboard paddle loses a portion of its power.

Let the line C D, (see fig. 3, in plate,) represent the stem and stern of a steam vessel, the laying shaft of the paddles will be in the direction A B, before the vessel can be brought round in the direction of the arrows, so that G H will be the direction of the stem and stern,

and E F that of the laying shaft; the paddle at B, will have the arc B F, to move through, while the paddle at A, (although still moving with a propelling power towards C,) will actually retrograde in the direction of the arc A E. If the paddle at B, moves at the same rate with that at A, it must lose a great portion of power, because it has to move through a much greater space in the same length of time, which will lessen the resistance opposed by the water to it. My opponent instanced the facility with which a boat propelled by oars is steered, and said that a steam boat ought to be the very same; but there is a wide difference between them. In the steam vessel there are always some of the paddles in the water acting against the rudder, in the manner before stated. The row boat, on the contrary, has time allowed for the action of the rudder between every pull, or new dip of the oars, without any resistance whatever between the rudder and the oars. The figure will not apply strictly to a vessel turning in the water, as, according to it, she is supposed to turn on a pivot, which, in fact, no vessel ever does at sea; it is not mathematically constructed, but merely a hand sketch to render the points on which I support my argument plainer than I could otherwise have done it.

Your's, &c.

S. Y.

I have lately read an account of the specification of a Patent granted for an improved mode of applying the floats to steam vessels, so as to obviate the objections to the present mode, by which a considerable portion of the power is uselessly expended before they reach the angle of 45°, which is the point I believe at which they begin to act in propelling the vessel *forward;* by the new method this objection is obviated, as, according to it, they enter and leave the water at about an angle of 45°. If an account of it would prove acceptable, I shall have much pleasure in transmitting you one as far as my memory will serve me, as I have not the book now in my possession. In theory it appears very plausible, I don't know how it may do in practice. The rotatory steam engine made a *very good picture,* but when brought to the test was found sadly wanting.—S. Y.

ON SOUND.

Mr. Editor,

According to your Correspondent G. M.'s opinion, the sound heard on holding the shell to his ear, was produced by the insensible perspiration arising from the ear striking on the shell. He must certainly have been in a terrible state of perspiration when he tried the experiment. All experiments in Chemistry, Natural Philosophy, &c., should be gone about with the utmost *coolness* possible. I would advise him to try *the experiment coolly* again. If *what he has* stated were true, the closer the shell is held to the ear, the greater the sound produced ought to be, now the very reverse of this is the case; for, if the shell is held so close as to cut off all communication with the external air, little or no sound is to be heard; this fact supports still more strongly A. B.'s opinion. I am quite of his way of thinking; it is clearly on the principle of the echo; the various sounds floating, as it were, in the air, are collected at a particular point, and thence reflected back, and striking on the tympanum of

the ear, produce the sound, and the confusion, and the multiplicity of the sounds entering the shell, prevents any one of them from being distinct.

S. Y.

EASY METHODS OF CALCULATING INTEREST.

As we promised in our last, we now insert short and easy methods of calculating interest, at 3, 4, and 5 per cent.

To find the interest of any sum for any number of days at 3 per cent.

1st Method.

RULE.—Divide the product of the sum and days by 600. The quotient is the answer *nearly*, in shillings; to make it exact, subtract 1d. for every 6s. in the product.

EXAMPLE.—What is the interest of £250 for 157 days, at 3 per cent?

```
              250
              157
        6,00)392,50
             65 „ 5
off 1d. for every }
   6/. in 65/. 5d. }  11
             64 „ 6 or
     £3 „ 4 „ 6 Interest.
```

2d Method.

RULE.—Multiply the product of the sum and days by 2, and cut off the two right hand figures (or, in other words, multiply by the decimal .02). The remainder is the answer *nearly*, in pence; to make it exact, subtract a penny for every 6s. in the product.

EXAMPLE.

```
                 250
                 157
               39250
                   2
           12)785,00
              65 „ 5
off 1d. for every 6/.  11
              64 „ 6 Interest.
```

To find interest at 4 per cent.

RULE.—Multiply the product of the sum and days by the decimal .00011. The product is the answer *negrly*, in the decimal of a pound. To make it exact, subtract 1d. for every £1 in the product.

EXAMPLE.—What is the interest of £250 for 157 days at 4 per cent?

```
                    250
                    157
                  39250
                 .00011
                4.31750
                     20
                  6.35
                     12
              £4 „ 6 „ 4
off 1d. for every £1,   4
              £4 „ 6 „ 0 Interest.
```

Or otherwise,

```
                    250
                    157
                 392500
                  39250
                4.31750
                  6.35
              £4 „ 6 „ 4
off 1d. for every £1,   4
              £4 „ 6 „ 0 Interest.
```

To find interest at 5 per cent.

RULE.—Divide the product of the sum and days by 30. The quotient is the answer *nearly*, in pence; to make it exact, subtract 1d. for every 6s.

EXAMPLE.

```
                       250
                       157
                 3,0)3925,0
                  12)1388 pence.
                      109 or £5 „ 9 „ 0
off 1d. for every 6/. in 109/. £0 „ 1 „ 6
                     Interest, £5 „ 7 „ 6
```

MISCELLANIES.

THE SCRAP GATHERER;

OR,

A Selection of Facts worth knowing.

"Science is not Science till revealed."

No. 8.—*Chemistry.*—In all the changes which are produced by the accession or abstraction of heat or light; in all the changes which are produced by the combination of two bodies, and the formation of a new compound, *chemical* action appears. Considering then the multifarious changes to which the bodies in the material world are constantly subject; considering the diversified nature and endless variety of forms which those bodies by every new change exhibit; and considering the astonishing results obtained by the most simple means, which appear in the compounds produced, it is obvious that the sphere of chemical action is wide and extensive, and, indeed, is only limited by the bounds of the material world itself. For, wherever the effects of light and heat are felt, few, or perhaps no kinds of matter, even those which seem the least susceptible of change, are exempted from their influence. In examining the nature, properties, and constitution of the atmosphere, the aid of chemistry is essentially requisite; in the extraction of metals from their ores, and in converting them to the numerous purposes to which they are applied in civilized society, almost all the processes are chemical; in investigating the nature, functions, and uses of vegetables, whether in the living or dead state; in acquiring a knowledge of the functions and properties of animals; and in the application of many parts, both of vegetable and animal matter, to a thousand valuable purposes, chemistry furnishes the principal means.

The application of chemistry to the improvement of the arts of civilized life, opens a wide field of contemplation. In many of these arts, as in the manufacture of glass and porcelains, in tanning, soap-making, dyeing, bleaching, baking, brewing, distilling, and in most of the culinary arts, almost all the processes depend on chemical principles; and it may be added, that there are numerous little processes in various branches of domestic economy, where even a slight knowledge of chemistry may often prove highly useful. But without extending farther on the utility and advantages of chemistry, that which has been already advanced, will afford abundant proof of the importance and universal application of the science.

9.—*Clocks and Watches.*—The art of measuring time by such complicated machines, is deservedly considered the most ingenious, if not the most useful, of all the mechanical arts, and well merits the attention of all who admire the sagacity with which the mind of man could contrive, or the patience and dexterity with which his hand could execute them. The construction of a watch, in particular, the works of which are so delicate, and are brought within such a narrow compass, that the whole machine sometimes does not exceed the size of *a shilling*, is truly wonderful, and affords a striking proof of what genius, aided by science, can effect. Well may the moralist, in illustrating his arguments for the divine creation of the world, select this contrivance as an instance of design. We can scarcely wonder that the ignorant and unenlightened savage, on first seeing a watch, should take it for an animal endued with life as well as motion, or the God whom the white man worships.

Clocks and watches agree so far in their general construction, that they are both composed of a series of toothed wheels, the axes of which are inserted in holes or depressions in metallic plates, which being joined together by pillars, constitute the *frame;* while they are connected with each other by their teeth in such a manner as, when acted on by certain powers, to produce a steady and nearly uniform motion, by which certain indexes, or *hands*, are carried round a dial-plate, and point out the regular lapse of time. Sometimes the construction of these machines is so similar, that they are to be distinguished chiefly by their size; so that a small table-clock, and a large watch, or time-keeper, differ very little from each other. But, in general, clocks are distinguished from watches by three circumstances; by the former regularly *striking* the hours, having their motion produced by *weights*, and regulated by a *pendulum*, while the latter either never strike the hour, or do so, only when part of their machinery is set in motion, and have for their moving and

regulating forces, *springs*, a *verge*, and a *balance*.

10.—*A very remarkable Wooden Dome*—was that of Halle du Blé, at Paris, which was destroyed by fire some years ago. Its construction, invented by a carpenter of the name of Molineau, was extremely simple, and surprised many that it had not been thought of before. It occurred to this man, that a thin shell of timber might be made so as to be nearly in equilibrio, and also when firmly hooped horizontally, to have all the stiffness that was requisite. The circular ribs comprising this dome, consisted of planks, nine feet long, thirteen inches broad, and three inches thick,—three such planks, bolted together, so that two joints met, forming each rib. All the pieces being small, no machinery was required for carrying them up. The ribs were connected together by horizontal timbers, and iron straps, which answered the purpose of hoops. When the work had reached a certain height, every third rib was discontinued, and the open space was glazed. At a certain height above this, again, every second rib was discontinued, and the vacuity in like manner glazed. Higher up, still, the heads of ribs were framed into a circular ring, so as to form a wide opening, and over this was placed a glazed canopy, in which was left a space for the escape of heated air. This dome, which was 200 feet in diameter, and only a foot thick in the sides, was extremely beautiful, and used to be spoken of with admiration by all who had seen it.

SOLUTIONS AND QUERIES.

THE question proposed by Rusticus, in page 286, is not properly put, for a rectangular board cannot be broader at one end than the other; but the board, as it is, may be cut to answer the conditions of the question, viz. at $5\frac{1}{4}$ inches from the thick end, the board will be (according to its description) 16.9 inches broad, and at 9 inches farther it will be 15.1 inches broad, $16.9 + 15.1 = 32$, the half of which is 16, which multiplied by 9, is $= 144$, a square foot.

G. D.

Query. A weaver's beam, 24 inches in circumference, has on it 95 rounds of cloth, $\frac{1}{16}$ of an inch thick—what is the length of the web?

G. D.

1. What is the best method of removing yellow spots from books or prints, that have been contracted by lying in damp places?

2. What is the best mode of cleaning books or prints that have been soiled by being carelessly handled?

3. What are the best ingredients for making a varnish for violins, their respective quantities, and what is the best method of laying it on?

4. What is the most improved method of blackening and polishing picture frames?

5. How is a colour to be composed that has the nearest resemblance to gold leaf?

6. What is the most improved method of mixing up, and painting a mahogany colour?

Your's,

J. W.

E. Wemyss, 17th May, 1824.

OPTICS.

Unusual Parhelia seen at the Cape.—On the 7th May, 1823, when the sun's lower limb had just dipped the water's edge, the Reverend Mr. Fallows observed several parhelia, viz. 4 on the left, and 3 on the right hand of the sun, and all cut by the horizon like the real sun. They had the same shape as the real sun, and were as high, but not so long. When the upper limb of the sun came in contact with the horizon, it and the mock suns appeared as bright points upon the water's edge, and then one of them instantaneously vanished. The barometer was at 30.2 inches, and the thermometer at 64°. Dr. Young supposes that these parhelia were only *fragments of coronæ*, formed by the defraction of a cloud rising but little above the horizon; and he attributes the absence of colours to the absorption of all the light, except the red, in its long passage through a hazy atmosphere.

The phenomenon, now described, we consider as very remarkable, and as one hitherto unobserved; but we cannot, for the following reasons, concur in the ingenious explanation of it given by Dr. Young:

1. Mr. Fallows distinctly states, that *not a cloud* was visible.

2. He distinctly describes, and draws the mock suns as having *exactly the shape of the real sun*,—a form which fragments of coronæ could not be supposed to assume.

3. He describes them as *equal in brightness* to the real sun,—which they could not possibly be, if they were fragments of coronæ, unless some obstructing medium obscured the light of the real sun, without affecting that of the coronæ.

Mr. Fallows describes the sky as *delightfully clear*, without a cloud visible, and the *sea horizon as remarkably distinct*, so that there appears to be no ground for a physical explanation of the phenomenon, unless we could suppose a recurrence in different azimuths on each side of the sun, of that condition of the atmosphere which produces lateral mirage. It deserves to be noticed, that according to the diagram of Mr. Fallows, all the mock suns were included in a space extending only *one degree and a half* on each side of the sun's centre.—*Edin. Phil. Jour.*

GLASGOW MECHANICS' INSTITUTION.

Directors for 1824.

Elected by ballot, 29th May.

Mr. James Watson, President,
Mr. James Syme, Vice-President,
Mr. Hugh Barclay, Treasurer,
Mr. William Murray, Superintend.
Mr. Hugh Wilson, Secretary,
Mr. John Liddel, Assist. Sec.

1. *Committee of Finance.*

President, Treasurer, Secretary, Messrs. James Aitken, jun. and Robert Kennedy.

2. *Committee for Library.*

Vice-President, Secretary, Assist. Sec. Messrs. James Brown, John Dykes, William Witherspoon, and M'Haffie.

3. *Apparatus Committee.*

Superintendant.

Messrs. Samuel M'Cormick, James Rankine, James Grandestone, and James Young.

John Culbertson, *Officer.*

SHEFFIELD PHILOSOPHICAL SOCIETY.

At a meeting of the Philosophical Society last month, Mr. Abraham gave an account of an instrument which he had lately invented, for the purpose of extracting particles of iron and steel from the eye. From the paper which was read, it appeared that the attention of this gentleman had frequently been drawn to the practice of extracting particles of steel from the eyes of the workmen by means of a penknife, or a lancet, which instruments Mr. Abraham naturally considered as dangerous, particularly when used by unskilful and unexperienced persons. Having been applied to by a young man (a die sinker) who had had a particle of steel firmly fixed in the centre of his eye for the space of 18 hours, Mr. Abraham applied a fine, but powerful magnet, which immediately attracted the particle, and afforded the sufferer instantaneous relief. The success attendant on this experiment, induced Mr. Abraham to construct an instrument which any person may use in cases of the most distressing kind—thereby affording relief to the most delicate of our senses, without the risk which is necessarily involved in the application of a penknife or a lancet.—*New Monthly Mag.*

PATENTS LATELY GRANTED.

(Continued from page 384.)

To E. Jordan, of Norwich, for an improvement in the form and construction of water closets, or of the apparatus connected therewith.—March 27, 1824.

To T. Gettien, of Pentonville, for Improvements in the machinery and process of making metallic rollers, pipes, cylinders, and other articles.—April 15, 1824.

To D. Tonge, of Liverpool, Shipowner, for an apparatus, by means of which, an improved method of reefing sails is effected.—April 15, 1824.

NOTICES TO CORRESPONDENTS.

If B. will look into this Number, he will find a shorter method of calculating discount than the one he proposes.—L. M'L. won't do; we think he might employ his ingenuity to better purpose.—J. P. may *know enough*, but he has told us nothing. The Scrap Gatherer must send off his despatches before Tuesday evening, if he wishes them inserted on the following Saturday.—J. W.'s queries are inserted, and his useful discoveries will be inserted *when we get them*, if they are really "useful and original." —We do not think G. D.'s solution of the clock question, sufficiently distinct for insertion, and the walking one is *run down*. His other communications are inserted.—If 'A Constant Reader' would specify what kind of articles he wishes to whiten, he may expect his query to be inserted, and perhaps answered, but not otherwise.—We have received A. N., W., and M. S., Lancaster, but they are unavoidably postponed.

Published every Saturday, by W. R. M'Phun, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed

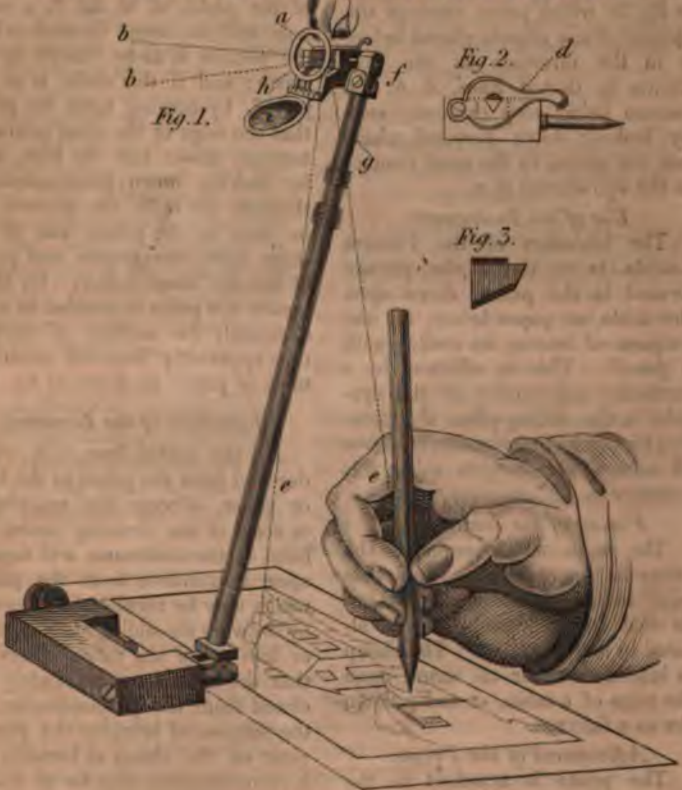
J. CURLL, PRINTER.

THE GLASGOW MECHANICS' MAGAZINE.

" Ere yet thy pencil tries her nicer toils,
Or on thy pallet lie the blendid oils,
Thy careful chalk has half achieved thy art,
And the just image makes the copier start."—*Tickell.*

No. XXVI. *Saturday, 26th June,* 1824. Price 3*d.*

Dr. WOLLASTON'S CAMERA LUCIDA.



THE CAMERA LUCIDA,

Invented by Dr. Wollaston,

For Drawing objects from Nature in true Perspective, and also for copying, reducing, or enlarging Drawings already made.

This ingenious instrument is represented in operation at fig. 1, and consists of a glass prism, *a*, mounted upon a stand, but seen detached at fig. 2, and in section at fig. 3; which prism receives the picture of any objects placed before it in the direction of the rays shown by dotted lines, *b*, *b*; the picture being very evidently seen by looking down perpendicularly into the prism, in the same manner as the eye situate at *c*.

Use of the Instrument.

The intention of the Camera Lucida is to throw the picture formed in the prism, down upon the table or paper below, for the purpose of tracing its outline with a pencil. This is effected by a particular adjustment of the eye-hole in the sliding-plate, *d*; attention to which circumstance, is, above all others, necessary in using this instrument.

Fixing of the Instrument.

The stem which supports the prism is connected by a double joint to the clamp at the bottom, so that its inclination may be altered in any direction. The clamp is intended either to screw upon the edge of a table, or to lie down flat as a fulcrum.

Adjustment of the Prism.

The prism is attached to the stem by means of its pin, which slides into a hole at top; and as the squareness of the picture depends upon the truly horizontal position of the axis of the prism, the joint, *f*, will allow of this adjustment. The prism must be turned vertically upon its pin, and horizontally by the sliding of the stem in its tube, until the flat glass face is directly opposite the object to be delineated.

Position of the Eye-hole.

In the horizontal representation of the plate, *d*, at fig. 2, a small hole will be seen, through which the picture is to be viewed in the prism; and if this slider is so adjusted, by turning upon its pivot, that the edge of the glass prism intercepts about half the hole, then by looking down perpendicularly through the hole, the picture will be seen in the prism, and at the same time, the fingers and pencil of the draftsman below. By these means the point is enabled to trace accurately the outlines of the picture apparently depicted upon the table or paper, as shown at fig. 1.

Magnitude of the Drawing.

As the dotted lines, *e*, *e*, which descend from the prism to the table or paper, *diverge*, the magnitude, or scale of the drawing under the hand of the draftsman, will depend upon its distance from the prism, which may be regulated at pleasure by drawing the sliding stem, *g*, more or less out of the tube; observing, that the stem must be slightly inclined from the perpendicular, for the purpose of bringing the picture clear off the clamp at bottom. It is recommended, that for all distant objects, the stem should be drawn out of the tube to the mark D, engraved upon it; and for objects that are two, three, four, or five feet from the prism, the stem should be drawn out only as far as the respective marks, two, three, four, and five; but after a little practice it will be found that such exactness need not be attended to.

Distribution of Light.

If the strength of light which falls upon the object to be drawn, and the light which falls upon the tracing pencil be equal, then the eye-hole may, as above, be cut by the prism exactly in the middle. But if the light upon the object be more intense than that which falls upon the pencil, the sliding plate must be drawn back a very small distance, in order to make the tracing point visible. Or if the light which falls upon the pencil be the strongest, then the sliding plate must be pushed forward a small distance over the prism, in order to make the object more distinct, which a little practice will make familiar. Bright day-light (but out of the sun-shine,) will always be most favourable to the use of this instrument: it may, however, be used by candle-light, attention being paid to the distribution of light, as above.

Copying, Reducing, or Enlarging.

If an original drawing be placed at one foot from the face of the prism, and the stem be extended so that a perpendicular line from the table to the prism be one foot, then the outline traced by the pencil will be a copy upon the same scale as the original. If the original be at two feet distance, and the table only one, then the copy will be half the scale. If the original be at one foot, and the table be at three feet, then the copy will be enlarged to three times the scale.

In this application of the instrument, care must be taken to place the centre of the original drawing directly opposite the face of the prism; and it is also to be observed, that the drawing to be copied should not be very large, or it would in that case become distorted towards the extremities.

Long and Short-sighted Eyes.

The instrument may be used with or without the lenses, *h* and *i*, attached to the prism. For an old or long-sighted person, the convex lens, *i*, should be placed under the prism, as at fig. 1. For a short-sighted person, the concave lens, *h*, should be turned before the prism; or, for a perfect-sighted person, they may both be dispensed with, and folded back.

DESCRIPTION OF AN APPARATUS FOR SINGEING MUSLIN BY MEANS OF GAS.—By Mr. John Hart.

Mr. Editor,—As your Correspondent, Mr. John Fergusson, has alluded to the machine for singeing muslins he erected for Messrs. Chisholms, from a sketch which I gave him for that purpose, an account of it may be acceptable to some of your readers, especially those interested in the business of singeing.

Sir Humphrey Davy, in his researches on the nature of flame, has proved, that the illuminating quality of carburretted hydrogen gas, depends entirely on the carbon contained in the gas, being kept at an intense white heat in the envelope of flame; and, if we interrupt the complete combustion of the gas, by the introduction of any body of lower temperature into the flame, part of the carbon will be deposited on that body in the form of soot, while the heat and light will be diminished. He also proved, that, if we mix gas with such a quantity of air, as will afford oxygen to combine with all the carbon to the very centre of the flame, we will destroy the illuminating power of the gas, but we will gain an increase of heat, without the possibi-

lity of any deposit of carbon; and he showed, that the simplest method of effecting this, is to make the gas pass up through a tissue of wire gauze, placed a few inches above the orifice from which the gas issues, before it is inflamed. By this means, the gas may be mixed with a due proportion of air, while the gauze will effectually stop the flame from communicating with the gas below.

Upon this last principle the machine was constructed.

This machine consists of a frame of wood, of the requisite breadth to take in the web, and of convenient length; furnished with the rollers and apparatus to raise the muslin of the singeing bar in the usual manner. Across the centre of this frame, a gas pipe, P, of large diameter, is placed, perforated with jet holes about one half inch asunder, and furnished with a stopcock to regulate the quantity of gas. A little above this pipe is placed a strip of wire gauze, *w w*, of the length of the perforated tube, and about four or five inches in breadth, bent in a semi-circular form, through which the gas which issues from the perforated tube will ascend, after mixing with the atmosphere. It is then to be lighted above the gauze. *f f f*, is the flame. The wire gauze, *w w*, must now be raised or depressed, according to the quantity of gas used; that is, it must be raised till the flame assumes a uniform blue colour, resembling the flame of alcohol, when the greatest heat will be obtained with the least expenditure of gas. *m m*, is the muslin, which runs over two small iron rods, R R, placed one on each side, a little above the wire gauze, to keep the muslin at the proper height.*

To apply this apparatus in a common singeing house, all that is necessary would be to remove the iron singeing bar from the furnace, and substitute a perforated gas pipe, above which is to be placed the wire gauze, and the two iron rods to support the muslin, with a means of adjusting the same; or, if it would be more convenient, the present rollers and lifters may be mounted in a new wooden frame in any apartment.

When, or by whom, singeing muslin by gas was first proposed, I cannot tell; an application so simple must have occurred to many about the time the gas was introduced. Without attempting to canvass the inventive merit of simply applying a flame for the purpose of singeing, according to the patent Mr. Hall took out in 1817, I may be allowed to observe, that his mode of applying gas for this purpose, lay under great disadvantages, especially with gas of a high illuminating power, (as oil gas, or gas from cannel coal,) because it would smoke the muslin. This, I am informed, proved to be the case when tried some years ago in Glasgow; and the reason, as your chemical readers know, is, that the muslin cools the gas below that temperature which is necessary for the complete combustion of the carbon contained in the inflammable gas.

Of the nature of Mr. Hall's amended process, I am not accurately informed; but, if it should resemble the one I have described, he can have no exclusive claim to its use; as Mr. Fergusson, according to his statement, already published by you, was in possession of the process in December, 1822, while the date of Mr. Hall's patent is the 6th April, 1823; that is, about four months afterwards. I might here give the names of a number of engineers, and other

* The wire gauze used ought to be formed of much thicker wire than that used for the safety lamp.

scientific persons, to whom I recommended, several years ago, the application of mixed or explosive mixtures of gas for the above purpose, and for others where heat alone is wanted, if I were not restrained by motives of delicacy.

Your's, &c.
JOHN HART.

Glasgow, 21st June, 1824.

SPECIFICATION, BY CHARLES MACINTOSH, Esq. F. R. S., OF HIS PATENT FOR WATER-PROOF DOUBLE FABRICS.

[In No. II. of our Magazine, we gave an account, at some length, of the process of this manufacture, with the promise to present to our readers the Specification of the Patent. This promise we now, with pleasure, fulfil. The deficiencies of our former article are so well supplied by the specification, which follows, that farther observations from us are unnecessary; except indeed that we ought to state, that, as was to be expected, the manufacture has been uniformly improving since its commencement; and that the *Patent Waterproof Double Fabrics* may now, with justice, be pronounced elegant.—ED.]

NOW KNOW YE: That, in compliance with the said proviso, I, the said Charles Macintosh, do hereby declare, that my said invention doth consist in a manufacture of two or more pieces of linen, woollen, cotton, silk, leather or paper, or other, the like substances, any or either, or combinations of any or either of the same, cemented together by means of a flexible cement; the nature of which said manufacture is, that it is impervious to water and air; and, in further compliance with the said proviso, I, the said Charles Macintosh, do hereby describe the process which I have found the best for performing the said manufacture, by the following description thereof: that is to say, I prepare caoutchouc by *cutting it into very* thin shreds, or pairings; and then steep it in the substance which is produced in making coal gas, commonly called coal oil. The quality of these ingredients is extremely various, and the relative proportions to be employed must depend on the quality of each; but, when the caoutchouc is of the best quality, and the oil pure, from ten to twelve ounces of the former, to a wine gallon of the latter, will be found to answer. This infusion I submit to a gentle heat, obtained from a water or steam bath; and I employ constant trituration until such time as the ingredients are reduced to a thin pulpy mass; when, to render the whole as homogeneous as possible, I pass it through a very fine wire, or silk sieve, or searce, and if this part of the process has been duly followed out, the varnish will be without any granular particles; and will, in appearance, resemble thin transparent honey. Fabrics, or substances, effectually united by cement thus prepared, in whatever way the union is effected, become both air and water proof; but, with a view to prevent the cement from appearing upon the surface of the manufactured article, and to ensure, at the same time, a perfect union of the substances, I, in the first place, distend the substances to be united, and with a brush, or other suitable instrument, lay upon the surface of each an uniform layer, or coating, of the varnish, or cement; and when this coating has, from evapo-

ration of the oil, which is extremely volatile, acquired a clammy viscous consistency, and this will take place in proportion to the heat of the atmosphere, and the current of air in which the manufacture is carried on, or to which the coated surfaces may be exposed,) I apply the varnished side of both substances to each other; and, by means of a callender, or rollers, or other suitable means, I powerfully press the fabrics, or substances, together, whereby they become united, and are rendered a compound fabric, or substance; and, thereafter, I expose this compound fabric and substance in a stove-room, or other suitable place, to a heat of from 100 to 140 degrees, for the double purpose of maturing the manufacture and obtaining a further evaporation of the oil, which, while it remains, gives a disagreeable effluvium. When the substances to be united are of an open texture, or not of a smooth and uniform surface, I apply a greater number of coatings of the cement, or varnish; and, when three or more fabrics, or substances, are to be united together, I coat with the varnish the substance, or substances, to be inclosed, on both sides, and complete the process, as before suggested. Further, in some cases, it may be sufficient to apply the layer, or coating, or coatings, of the varnish upon one side only, of one of the fabrics, or substances, applying the other fabric, or substance, uncoated, upon the clammy viscous surface of that which has received one or more coatings of the varnish; and then complete the process, as before suggested.

Now, whereas, caoutchouc, in a state of solution, and dissolved in manner herein-before described, is well known to chemists and others, and not new. Therefore, I do not claim any right, title, or privilege, in respect of the same. But as a manufacture of two or more pieces of linen, woollen, silk, leather, or paper, or other the like substances, any or either, or any combination of any or either, the same connected together by means of flexible cement, in manner herein-before described, being, to the best of my knowledge and belief, entirely new, and never before used in these kingdoms; I do hereby declare this to be my specification of the same, and that the said specification doth comply, in all respects, fully and without reserve, or disguise, with the said proviso in the said, in part, recited letters patent contained; and I do hereby propose to maintain my exclusive right and privilege to the same invention.

ON THE STABILITY OF PARTITIONS.—By Mr. Robert Hart.

Mr. Editor,—Your Glasgow readers are indebted to your Correspondents, Messrs. Capital and Doorway, for their just observations on the external decorations of our buildings. Passing from their exterior, allow me to make a few observations on a very important defect, which injures both their appearance and stability.

It is well known to builders, that the inside partitions of a building are often rent, when the external walls are standing, without the least appearance of any part having given way.

Having experienced this evil, I applied to practical people, with a view of learning its cause, but the only satisfaction I could get from them was, the assurance that it was found in the best houses, and that its cause was not well understood.

Thus baffled, I turned my attention to the subject, and I am now

enabled to point out what, I hope, will be considered the true cause of the defect in question.

At first view, we are led to believe that it is owing to the sinking of the found; on examining the under partitions, we in general find them perfect, while the higher are always most rent. The defect appears to me to originate in the mode of constructing partitions of lath and standard. They are commonly constructed as follows:—the foot of the standards are nailed upon the top of the joists, and their upper ends nailed to a runner underneath the joists above, and so on; thus introducing, between each successive partition, a thickness of at least twelve inches of side wood, commonly new from the saw-pit, and of course wet. Now, in a house of four flats above ground, there is fully four feet of side wood, the contraction of which will not be much less than two inches; can we wonder, then, that a partition of this sort should rent when joined to a wall or partition that is raised from the ground?

The preventive for this is very simple:—let the standards of every successive partition rest on those below, and the lower ones fixed as near the bottom of the lower joists as possible, if they cannot get a rest from the ground; that is, avoid all side wood if not well seasoned, and no shrinking will take place.

Your's, &c.

ROBERT HART.

Glasgow, 21st June, 1824.

ON THE VARIETIES IN THE HUMAN RACE.

"Unguided in the dark, we strive to find,
With fruitless toil, the source of human kind,
Unless we call our Author to our aid."—*Blackmore.*

THE natural organization of man, while it subjects him to those laws of birth, growth, and dissolution, which extend to all orders of living beings, possesses a character so peculiar, so extraordinary, and so sublime, that it is impossible to suppose even the most distant relationship between the brutes, which do nothing but feed and propagate on the surface of the earth, and him who is born to exercise dominion over them. That upright and elevated port, which indicates both dignity and courage; those hands, the trusty instruments of his will, the dextrous performers of the most magnificent as well as the most useful works; those eyes, uplifted from the dust, whose intelligent glance can survey the immensity of the heavens; those organs, which enable us to express thought by articulate sounds of endless variety; the admirable union of strength and agility in all his members; and, finally, the harmony and perfection of all his senses, assign to him the first rank amongst created beings, and give him both the right to claim, and the power to hold, the empire of the earth.

These truths have been placed beyond dispute, by the researches of anatomists and physiologists; while it is evident that those naturalists who have pretended to confound the human with the monkey species, notwithstanding the essential difference in the feet, in the organs of speech, and the notes of the voice, independent of the thinking principle implanted in man, must have been actuated more by a spirit of misanthropy, than by a knowledge of the true principles which lead to a proper classification of the various species of animal nature.

Even the apparent disadvantages of our organization, powerfully accelerate the improvement and the

happiness of the human species. Had he been endowed with the strength of the lion, enveloped in a natural coat of mail like the elephant, or clothed with a skin alike impenetrable to cold or humidity, he should most probably have remained, during the whole period of his existence, benumbed in stupid indolence, and ignorant of all the arts of civilized life. The extreme feebleness of the human frame at the moment of its birth, the slowness of its growth, the multiplicity of its wants, with all those ills and all those infirmities which nature has appointed as our attendants in the journey of life, serve as so many spurs to quicken our dormant faculties, and as so many bonds by which man is knit together with man. Hence the origin of civil society. From the long helplessness of infancy, arises the endearing relation of parents and children; and from this relation springs also the permanent nature of the conjugal union. The union of mankind in families is followed by that of tribes and nations. It is by uniting with his fellows, and living together under one common law, that has made man what he is, and so different from other animals; it is by observing his own weakness, and by inventing instruments to assist it, that he has obtained the mastery and the management of the inferior powers of nature; he felt his poverty, and the stimulus of this uneasy feeling procured for him his true wealth.

This animal, so distinguished from all others, forms in the scale of being an insulated *order*, which contains only one *genus*, and one *species*; the differences observable in the various tribes of the human race cannot be referred to different species, because they are confined to qualities which we see every day varying according to the nature of the food which is eaten, and from the influence of climate and disease. These differences relate to the stature, the physiognomy, the colour of the skin, the nature of the hair, and the form of the skull, or cranium. It is well known that a simple mode of life, abundance of nutritious food, and a healthy atmosphere, give to all organic beings, large and graceful forms. This is evinced by the case of the Laplanders in the North, and Hungarians in the South of Europe, whose language clearly indicates that they were originally sprung from the same stock, although they now differ in a very great degree from each other, both as to stature and gracefulness of form; the former being small and mis-shapen, while the latter are large, beautiful, and well formed; this sufficiently proves that the beauty of the same race varies with the climate and the qualities of the country. The Germans, as they were described in the Annals of Tacitus, the Roman Historian, when his countrymen first made their inroads into that quarter of Europe, are no longer to be found in Germany, civilized, and cultivated as it has been since that period; whilst the Hollander, who is scarcely in his own country above the ordinary stature, has become, in the interior colony of the Cape of Good Hope, almost a giant. How many contrasts do we not meet with in a single nation, and at very short distances. The female peasants of Westrogothia are uncommonly pretty, while those of Dalecarlia are in general ugly, although both these provinces of Sweden occupy the centre of the real country of the Goths. But why do we search for differences in the same quarter of the globe, in the same country, in the same nation, or in the same tribe, when we often meet with them in the same family? To

account for these differences is a more difficult task, especially in civilized countries. Violent passions, the yoke of superstition, dull or cheerful occupations, habits of activity or indolence, stamp a permanent character on the physiognomy of whole nations. Several differences of physiognomy are partly, at least, allowed to be the effect of art. Numerous eye-witnesses agree in assuring us that the negroes, the inhabitants of Brazil, and the Carribees, the people of Sumatra, and those of the Society Islands, flatten with great care the noses of new-born infants; now, though there is reason to believe that this practice could not give rise to such a hereditary configuration of the face, yet it contributes to render the exceptions either impossible, or extremely rare.

Variety of colour seems, in a great measure, also to depend upon external circumstances. In the same nation, we often observe individuals of extremely different complexions. Whilst the Moorish ladies, shut up in their houses, and scarcely ever exposed to the sun, have complexions of a dazzling whiteness, the women of the lower ranks, even in their youth, acquire a colour approaching to that of soot. The Abyssinian Mountaineers, or High-land-ers, are as fair as the Spaniards, or Neapolitans, while the inhabitants of the plains of that country, or Low-land-ers, are almost black.

Amongst the Creoles, or Europeans born in India, the women are distinguished from their sisters born in Europe by the sprightliness of their looks, and the ebony or jetty colour of their locks. The application of the principles which we owe to the discoveries of modern chemistry, enables us to explain not only the reason of this change of colour from the circumstances of the heat of the climate, and the action of that heat upon the substances of which the body is composed; but also why the skin of white people grows black in some diseases, whilst that of negroes, under the same diseases, grows white or rather yellow. There is one difficulty, however, which attends this explanation, and which has occasioned considerable discussion amongst the learned. It is said that if negroes, descended from a race originally *white*, millions of years must have elapsed before the repeated action of climate could have rendered their black colour hereditary. But geological monuments, besides the testimony of revelation, show that the antiquity of the human species falls greatly short of such a period. Either, then, will some philosophers say, either allow for the action of the causes which have formed the various races of men, an immense series of ages, or else admit that these races, if they have existed for only five or six thousand years, must have sprung from different pairs, that were originally stamped with all the characters of their descendants. Formidable as this objection appears to be, there would be no difficulty in the adherent of the Mosaic chronology finding out a reason that would satisfy himself, whether it might or might not appear satisfactory to the mere speculator in human opinions.*

* The American Dr. Dwight records, in his *Travels in New England*, a curious physiological change in the human species which fell under his own observation. He saw a negro in Virginia, whose complexion, without any apparent cause, or diminution of health, was gradually becoming white, and that not leprous or cadaverous, but fresh and healthy. According to the man's own account, the change was first perceived under and round the roots of his finger-nails, and proceeded faster on those parts where the

The numerous varieties of hair depend in like manner upon the chemical action of the elementary substances of which the body is composed.

(*To be continued.*)

skin was covered than where it was exposed. In four years the breast, arms, legs, and thighs, had become wholly white; the hands, feet, and face, were hideously spotted; the skin of the head was changed in spots, and wherever it was changed, the hair had become straight and flaxen. In four years more the change was almost complete. From the beginning he had been a hale, sound man; and no change had taken place in his habits of life; nor was he conscious of any peculiar sensation, except that where the discolouration was going on, the skin was in a slight degree more sensitive than elsewhere. The same process had taken place to the same extent in one civilized *Indian*, and had commenced in three others. Dr. Dwight infers from these and similar facts, that the present difference of complexion does not prove the human species to have sprung from different stocks. He observes, that the Jews have every tint of complexion, from that of Poland, Germany, and England, to that of the black Jews of Hindostan; and that the Colchians, who were black in the time of Herodotus, are now as white as the Europeans.—*Examiner.*

ON ELECTRICITY.

THAT consequences, replete with interest and importance to mankind in general, result in very many cases from the observation of facts, which, at their discovery, have appeared trivial, is a truth which must be allowed by all. On a slight attention to the annals of philosophical discovery, we cannot fail to observe, that those phenomena which now rest on the firm basis of experience and observation, were at first founded on the discovery of peculiar properties inherent in bodies of particular descriptions.

This observation of the properties and qualities of objects has been operated upon by philosophers in many various ways. Transformations of a singular nature have been made, the limits of quantities and the nature of qualities have been decided and determined upon, methods, various in their natures as in their effects, have been adopted and acted upon for simplifying every branch and department of science, and the bounds of natural knowledge have been extended by the genius, industry, and research of men who have surveyed nature in every attitude, which seemed to afford any prospect of discovering her secrets.

The discovery of the Milesian philosopher, of the attracting power of amber, when excited by friction, has led to results of a very interesting nature, and the name Electricity, derived from the Greek word ἤλεκτρον, signifying *amber*, has been given to that science—an account of some of the general principles and laws of which is to form the subject of the following sketch.

It seems to be universally admitted, that Thales, who lived about 600 years before our era, was the first who remarked the electric property of amber. The power this substance possesses of attracting light bodies, appears to have remained as an insulated fact, unapplied and uninvestigated, and to have excited little if any attention from ancient philosophers. Indeed, until the begining of the 17th century, it had not assumed the appearance of a science.

In the year 1600, a treatise De Magnete was published by Dr. Gilbert, a London physician, in

which many important and interesting experiments and discoveries with regard to the nature of electricity were detailed. Although experiments in this science continued to be made by Boyle, Otto, Guericke, and Dr. Wall, nothing of great importance appears to have been suggested till the beginning of the 18th century, when Mr. Hukskbee discovered the great electrical power of glass. He also first remarked the light proceeding from, and the noise attendant on the excitation, along with many phenomena relating to electrical attraction and repulsion; and introduced a glass globe into the electrical machine, by means of which his after discoveries were very much facilitated.

After a lapse of nearly twenty years, Mr. Stephen Grey, a pensioner in the Charter House, discovered accurately the distinction between electrics and non-electrics; that is, between those bodies which are capable of being excited to electricity, and those which are only capable of receiving it from others.

About this time, the science of electricity began to excite more general attention, and improvements of various kinds were made, all of which we are unable to notice particularly. The most remarkable and important of these was the accumulation of the power of electricity, by means of coated jars, by which the method of giving the electric shock was much simplified and improved.

This discovery was accidentally made in the year 1745, by M. Van Kleist, dean of the cathedral at Cammin, a maritime town of Germany, in the province of Pomerania. He communicated his discovery to several of his friends, to one of whom he thus writes.—"When a nail or a piece of thick brass wire, is put into a small apothecary's phial and electrified, remarkable effects follow; but the phial must be very dry or warm.—I commonly rub it once beforehand with a finger on which I put some pounded chalk. If a little mercury or a few drops of spirit of wine be put into it, the experiment succeeds the better. As soon as the phial and nail are removed from the electrifying glass, or the prime conductor to which it has been exposed is taken away, it throws out a pencil of flame so long, that, with this burning machine in my hands, I have taken above sixty steps in walking about my room. When it is electrified strongly, I can take it into another room, and there set spirits of wine on fire with it. If, while it is electrifying, I put my finger or a piece of gold, which I hold in my hand, to the nail, I receive a shock which stuns my arms and shoulders."

This method of communicating the electric power, received the name of the Leyden Phial, from having been more perfectly made, and more accurately defined soon after, by Cunæus, a native of Leyden. In attempting to communicate the electric power to water contained in a phial, in which was a nail, he was very much astonished at receiving a very smart shock in his arms and breast, when he removed the phial from the prime conductors. This result attracted universal attention, and the effects of the electric shock were described by various philosophers, in a manner which excites our wonder at their timidity.

One of these intrepid adventurers felt himself struck in his arms, shoulder, and breast, in such a manner that he lost his breath, and continued under the effects of this dreadful shock for the space of two days, so that he declared he would not submit to a repetition of it for the whole kingdom of France. Such an account of it might have deterred

the boldest spirits from attempting such another experiment, had they not been philosophers; but some more adventurous than the rest having repeated it, and found it not quite so dreadful as they imagined, more powerful machines were constructed, and numerous highly curious and interesting experiments were made with them.

This instrument has been found to apply perfectly to all the purposes intended, and to be at once simple and commodious.

Having premised this short sketch of the progress of the science of electricity, it remains to state a few general principles with their results.

Every one knows that when a glass rod is rubbed with the hand, or a piece of dry silk, sparks of light will, after some time, dart from its surface; and that, upon the approach of light bodies to it, they are, when it is in this state, alternately attracted to and repelled from it. A slight shock will be received under these circumstances, by any one who applies his knuckle to the closed end of the tube.

Taking a metallic rod of the same size and appearance, and performing exactly the same process with it, no similar result will follow. Although a much greater quantity of friction was applied to it, its state would remain unchanged, and would present no such phenomena. Hence a very easy first principle presents itself, in the distinction of bodies in their relation to electricity, into two classes; electrics, or such as are capable of being excited by friction, so as to show the action of the electric power; and non-electrics, or those which are incapable of being excited, or of producing electrical phenomena.

Although these last are incapable of being excited themselves, yet, if placed in contact with an excited electric, they receive a portion of the electric power from it, which they have been found capable of conveying to any distance. Hence another distinction is formed of conductors and non-conductors. Glass, resinous substances, oils, and aeriform fluids, being electrics, are the principal non-conductors; metals, some saline and earthy substances, with water, are the principal conductors.

(To be continued.)

MISCELLANIES.

THE SCRAP GATHERER;
OR,
A Selection of Facts worth knowing.

"Science is not science till revealed."

No. 11.—*Of the Mechanic Power.*—When we survey the vast variety of complex machines, which one of our great manufactories, for instance, exhibits, we are struck with astonishment, and the creative genius of man appears to the greatest advantage; but the surprise of the unscientific person will be increased, when he learns that this vast assemblage of mechanism is reduced into six simple machines, or powers, from which, and their different combinations, the most stupendous works of human art are produced. These machines are—1. the lever—2. the wheel and axle—3. the pulley—4. the inclined plane—5. the wedge—and 6. the screw.

The *lever* is, perhaps, the simplest of all the mechanic powers, and was probably the first which was brought into use. It is a bar of iron, or wood; one part of which is supported by a prop, and upon that prop all the other parts turn as on their centre of motion. We see the lever made use of in one form or other every day; when a labourer takes a handspike, or large stake, and putting a stone under some part near the end, by putting the extremity under a cask, a piece of timber, or any other body, and attempts to move it, by pulling at the

other end, he makes use of a lever. The handle of a pump is a lever also; even the poker with which we raise the fire is a lever; the bar of the grate is the prop; and the end which we hold in our hand, is the strength, or power. This is, however, not the only kind of lever; for, in fact, there are three different ways of using the lever, and from the different ways of using it, it is called a lever of the first, second, or third kind—viz. of the first kind, when the weight is on one side of the prop, and the power on the other; of the second kind, when the weight is between the prop and the power; and of the third kind, when the power is between the prop and the weight.

The *wheel and axle* is an engine, consisting of a wheel fixed upon the end of an axle, so that they both turn round together at the same time. The power being applied at the circumference of the wheel, the weight to be raised is fastened to a rope that coils round the axle. The capstan used on ship-board, for the purpose of weighing anchors, is a cylinder of wood with holes in it, into which are put bars, or levers, to turn it round; these are like the spokes of a wheel without the rim. Sometimes the axis is turned by a winch fastened to it, which, in this respect, serves for a wheel, and is more powerful in proportion to the largeness of the circle it describes, compared with the diameter of the axle.

A *pulley* is a small wheel turning round our axis, called its centre pin, with a drawing rope passing over it. The pulley neither assists, nor impedes the power, but only serves to change the direction of the power, from the vertical direction to the horizontal one, or from the ascending direction to a descending one, &c.—But the great use of the pulley is in combining several of them together; the advantages which arise from this combination are, that the machine takes up little room, is easily removed, and raises a very great weight with a moderate power.

The *inclined plane* is made by planks, bars, or beams, laid aslope; by which large and heavy bodies may be more easily raised or lowered, by sliding them up and down the plane; and the increase of power is in the proportion of the length of the plane to its height. In drawing a weight upon an inclined plane, the power acts to the greatest advantage, when its direction is parallel to the plane.

The *wedge*, which resembles two inclined planes, is very useful to drive in below very heavy weights, to raise them only a small height, and to cleave and split blocks of wood and stone. The power exerted by it is in proportion of the slant side to half the thickness of the back. So that, if the back of a wedge be *two* inches thick, and the side *twenty* inches long, any weight pressing on the back, will balance *twenty* times as much, acting on one side. But the great use of a wedge lies in its being urged not by pressure, but usually by percussion, as by the blow of a hammer, or mallet; by which means, a wedge may be driven in below, and so to be made to lift almost any weight, as the largest ship, by a *man* striking the back of a wedge with a mallet, it is the most powerful of all the simple machines.

The *screw* is a kind of perpetual inclined plane, the power of which is still farther assisted by the addition of a handle, or lever, where the power acts; so that the gain in power is in the proportion of the circumference described, or passed through by the power to the distance between thread and thread in the screw. The uses to which the screw is applied, are various, as the pressing of bodies close together, such as the press for napkins, for bookbinders, packers, hot-pressers, &c. As the screw is never used without applying a lever, or winch, it cannot properly be called a simple machine.

12.—The roof of the Riding-School at St. Petersburgh, said to be the production of a native of Scotland, is one of the most scientific, and certainly the largest roof we have ever heard of. Whoever attentively considers the width of this roof, viz.—126 feet clear within the walls, the lowness of its pitch, the skilful adjustment of its various pieces, to the nature of the offices which they perform, and its general indication of judicious design, with the production, at the same time, of very pleasing effect, must admit, we believe, that, both as a study and a model, it merits the very highest commendation. It is considered by many excellent judges, to be a master-piece of carpentry.

13.—*Steam-Vessels.*—From an article in the last Number of the Supplement to the Encyclopædia Britannica, we learn that the number of steam-vessels now employed in Great Britain is 160. The largest in size are the packets which ply between Leith and London; and next to those are the packets which ply be-

tween Liverpool and Greenock, and between Liverpool and Dublin.

14.—*The Construction of a Diving-Bell.*—It is an empty vessel, in the form of a bell, or truncated cone; the larger base is open, and the smaller closed, and made so heavy as to sink in water. Its ingenious inventor, Dr. Halley, was one of five persons, who, inclosed in a diving-bell, were let down to the depth of nine or ten fathoms of water, for above an hour and a half at a time, without experiencing any ill effects. He says he might have continued there as much longer as he pleased. By the glass alone, so much light was transmitted, when the sun shone, and the sea was clear and even, that he could see perfectly well to read and write, and to take up any thing that was under the bell; and by the return of the air-barrels, he could send up orders, written with an iron pen on small pieces of lead, when he wanted to be removed from place to place. But in misty weather, or when the sea was rough, it was nearly dark in the bell, and he was then obliged to burn a candle, which consumed about as much air as one person.

POISONS AND THEIR ANTIDOTE.

(Continued from page 174.)

COPPER.—All the preparations of copper are poisonous. The most common are the acetate, the sulphate, the nitrate, the muriate, the ammoniuret, as chemical poisons. In domestic use, those of ordinary occurrence are solutions of the metal in wine or vinegar, and its combinations with oily matters.

In many countries, and particularly in France, where copper vessels are much used in cooking, this poison is very frequently called into action, and it is therefore important that it should be well known. These poisons, however, are always taken inadvertently, never given with design to kill. There is no doubt that milk also acts in copper vessels in particular cases, and produces poisonous effects. A case is related by Dr. Darwin, where the mistress of a dairy farm suffered, merely from a custom of frequently tasting the cream at the edges of the milk pans. Verdigris is one of the most active of these poisonous preparations.

The ordinary symptoms are, an acrid metallic taste, with dryness of the mouth and tongue and constriction of the throat. Spitting, nausea, with vomiting, or vain efforts to vomit, follow. There are pains in the stomach and bowels, alvine dejections, sometimes black or bloody, with tenusmus, and the abdomen is inflated. The pulse is small and irregular, and generally hard and frequent; with debility, burning thirst, difficulty of breathing, cold sweats, dysuria, headach, vertigo, cramps, convulsions, and death. These do not, however, often occur in the same person; and the most common ones are vomiting, with colic pains. Gangrene sometimes takes place, and is easily known by its common symptoms.

The appearances, after death, are an inflamed or gangrenous state of the alimentary canal, and sometimes they are corroded into holes, as happens with arsenic.

Treatment of the Patient.—The alkalies and alkaline sulphurets are not antidotes to copper, because, though they decompose the salts, they leave the oxides, which are equally destructive. Nor has the infusion of galls been of any use. Sugar has very unexpectedly been found an antidote, as it renders the soluble acetates insoluble, and comparatively innocent.

The best practice, therefore, if sugar can be procured, is to give it in large quantities dissolved in water, by which means vomiting is at the same time encouraged. If that is not at hand, warm water, or broth, or any vegetable drink, must be given, and that in large quantities. It is unsafe to use emetics, and they should only be adopted in case it is impossible to excite vomiting in any other way. If, however, the poison has been so long taken that vomiting has ceased, and there are pains in the abdomen from its having passed into the intestines, vomiting must be avoided, and we must have recourse to emollient injections, and to the usual antiphlogistic remedies. When spasms and convulsions are present, anodynes and antispasmodics are proper.

This treatment applies alike to all the other preparations of copper.

NOTE.—*Effects of Copper on Vegetation.*—Some time since (says Mr. Phillips) I accidentally spilt some solution and oxide of copper near the root of a young poplar tree. In a short time, the tree began to droop; the leaves on the lower branches dying first, and eventually those on the upper ones. On cutting a branch from the tree, I observed that the knife was covered with copper to the whole breadth of the

branch, showing that the copper had been absorbed, and had undoubtedly proved fatal to the life of the tree.—*Ann. Phil.*

SILVER.—The only preparation of this metal likely to act as a poison, is the nitrate, which has been used in medicine; particularly of late in epilepsy.

When injected into the veins, it produces death speedily, and without our being able to ascertain the cause. But we shall notice these effects no more; as there is scarcely any substance, apparently the most simple, which does not in the same way produce death, and with the same trains of symptoms. The action on the animal economy, in these cases, is not understood; but, in a practical view, it is of no moment, as death does not occur, either accidentally or designedly, in this way, unless in the case of experiments on animals.

The symptoms which nitrate of silver produces when taken into the stomach in a large dose, are exactly the same as those caused by the other metallic poisons. Blueness of the lips, from the change induced on this salt from exposure to light, is an additional symptom, which, when it is present, serves to indicate the nature of the poison. The appearances after death differ in nothing from those caused by the other metallic poisons.

When nitrate of silver has been given medicinally in small dozes for any length of time, it is deposited between the skin and epidermis, producing a livid stain which can never be discharged, and which causes a great deformity through life. This has frequently happened in the hands of ignorant practitioners, but it begins to be more generally known. This consequence is so disagreeable, that the medicine ought to be rejected in medical practice, as it possesses no advantage over the other metallic tonics to compensate for this inconvenience.

Treatment of the Patient.—The muriate of soda, or common salt, decomposes this substance, and destroys its deleterious qualities.

Salt should therefore be given immediately, diluted in much warm water. Mucilaginous drinks may then be given to diminish irritation, followed by the antiphlogistic practice where necessary. —*Ed. Encyc.*

Test-Paper for Acids, Alkalies, and Compound Salts.—A useful test-paper has been submitted to the Society of Arts of London, by Mr. Thomas Griffiths. Acids change the blue colour of the test-paper into red, and alkalies change it into green. It is thus prepared: A pound of the minced leaves of red cabbage, are boiled in a pint of distilled water, till all the blue colour is extracted. The liquor is then strained through a cloth or sieve, and the clear infusion, which is of a fine blue colour, is to be evaporated to half its bulk, and poured into a shallow dish. The paper may then be dipped into it, and hung on lines to dry. A sheet of the filtering paper, which is the kind used, absorbs two fluid ounces of the infusion. With this test-paper, only one drop of the solution to be boiled is required. There are, no doubt, several processes, in which a test for acid and alkali at one operation may be found advantageous.—*Ed. Phil. Jour.*

ANECDOTE OF MR. MACLAURIN.

Mr. Maclaurin, the celebrated Professor of Mathematics in Edinburgh College, and the very able expounder of Sir Isaac Newton's *Principia*, always dislocated his jaw and was unable to shut his mouth when he yawned. At the same time, his instinct of imitation was so strong that he could not resist yawning when he witnessed that act in others. His pupils were not slow in discovering and taking advantage of this physical weakness. When tired of his lecture, they either began to yawn, or open their mouths in imitation of that act, and the prelection was interrupted. The Professor stood before them with his mouth wide open, and could not proceed till he rang for his servant to come and shut it. In the meantime, the mischievous enemies of Euclid effected their escape.

QUERIES.

A Correspondent wishes to know from the Scrap Gatherer, "whether the six hundred horse power engine he mentions, as being in Cornwall, is of the common kind, or what is called atmospheric, or on the patent plan? what are the sizes of the beam and cylinder, and for what purpose this King of Engines is used, as every person he has heard speak of it, doubt very much of its existence?"

Another Correspondent would be glad to be informed by any of our readers, if there is any better way of whitening wood and bristles, than by the process of smoking them with sulphur?

MONUMENT TO THE LATE J. WATT, Esq.

A numerous and highly respectable Meeting was held on Friday, the 18th instant, at the Freemasons' Hall, for the purpose of raising a Subscription to erect a Monument to the Memory of the late James Watt, who by his genius and science has multiplied the resources of his country, and improved the condition of mankind.

The Right Hon. the Earl of Liverpool took the Chair at two o'clock, supported by Lord Bexley, Sir James Mackintosh, Sir Humphrey Davy, P. R. S., the Chancellor of the Exchequer, Mr. Secretary Peel, E. J. Littleton, Esq. M. P., C. Grant, Esq. M. P., W. Wilberforce, Esq. M. P., H. Brougham, Esq. M. P., the Earl of Aberdeen, and many other Gentlemen of distinction.

The Earl of Liverpool, Sir Humphrey Davy, Mr. Bolton, Mr. Brougham, and a number of other Gentlemen addressed the meeting at great length, on the important benefits which have resulted from the numerous improvements made by Mr. Watt. But, as our limits will not allow us to do justice to the whole of the speeches, we can only give room to the following extract from the speech of Sir James Mackintosh.

"When I reflect that but 60 years have elapsed since the introduction of this great power, and that it is a much shorter period since Mr. Watt has applied it to purposes of practical utility; and when I recollect the delightful description given of that power by my Hon. Friend the President of the Royal Society, I must confess that my astonishment is greatly excited. Let us look over the globe, and we find its powers every where in motion—in the bowels of the earth, upon the highest mountains, upon the face of the waters, from the Mississippi to the Ganges, the name of Mr. Watt is heard, and the benefits of his invention are felt. (Applause.) I heard only the other day that all the great rivers in South America were now navigated by steam; so that the savage who inhabits the forests of Guiana, feels alarmed at the appearance of a monster, which makes its way upon the waters, without apparent effort or moral agency. (Applause.) From the Orinoco to the Magdalena, the name of that great man, and the blessings he has conferred upon mankind are resounded. (Applause.) If so much has been done in so short a time, what may not a sanguine hope whisper to itself, as to the future? For myself, I confess, that in contemplating what has been already done, I entertain trembling hopes, which I should not wish to expose to the eye of the scorner. But I feel that still nobler things are reserved in the unopened volumes of destiny."

Before the meeting broke up, the most of the gentlemen present subscribed. Amongst the donations, were noticed, the King, £500; Mr. Bolton, £200; Earl of Liverpool, £100; Peter Ewart, Esquire, £100; H. Turner, Esquire, £100; B. Gott, Esquire, £100; Lord Bexley, £50; Earl of Aberdeen, £50; J. Motteux, Esquire, £50; Walter Boyd, Esquire, £50; G. Rennie, Esq., £30; J. Rennie, Esquire, £30; Mr. Phillips, M. P. £25; Stewart Nicholson, Esquire, £25; G. A. Lee, Esq., £25; Mr. Huskisson, M. P., £25; Mr. Peel, M. P., £25; Mr. Robinson, M. P., £25; Mr. Rothsley, £25; Sir James Graham, £21; F. Lewis, Esq. £20; Messrs. Teesdale and Symes, £20; Mr. Brougham, 5 guineas; Dr. Birkbeck, 5 guineas; Mr. Wedgwood, 5 guineas, &c. &c.

NOTICES TO CORRESPONDENTS.

L. M'L.'s suggestion is good, but requires consideration.—We are obliged to J. M., Dumbarton, for his long paper, but as his methods of calculating interest are very tedious and well enough known, we must return them.—The "Scrap Gatherer's" request will be granted; he may call at the Publisher's for his proofs.—J. N. and J. D.'s queries are inserted.—We have received J. D. C.'s solution of the question given by D. B. in page 211, but for want of time we have not been able to look it over. We are afraid we must exclude it on account of its length.—We have received "Rusticus," and are sorry we cannot insert his queries, as there is more of the curious than the useful in them: his solution of the weavers' beam is deferred.—We agree with W. C. that in calculating interest by the method we have proposed, 1d. should be taken off for every 6s. 1d. in place of 6s. in the 3 and 5 per cent. methods, and 1d. for every £1 2s. 3d., &c. in place of £1. but we conceive it unnecessary to be so minute in common transactions. W. C. still maintains that his method is the simplest and shortest; our readers have now both before them—let them choose the best, only we dare say some of them are as much at a loss as we are to understand how W. C. can (even by his own table) make out that 19 is contained 5¼ times in 217 and 8 days over, or 19 in 152 is 6 times and 5 days over: by the bye, how does he calculate interest when it is for a less time than 19 days? not by *his* table, surely?

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THE GLASGOW

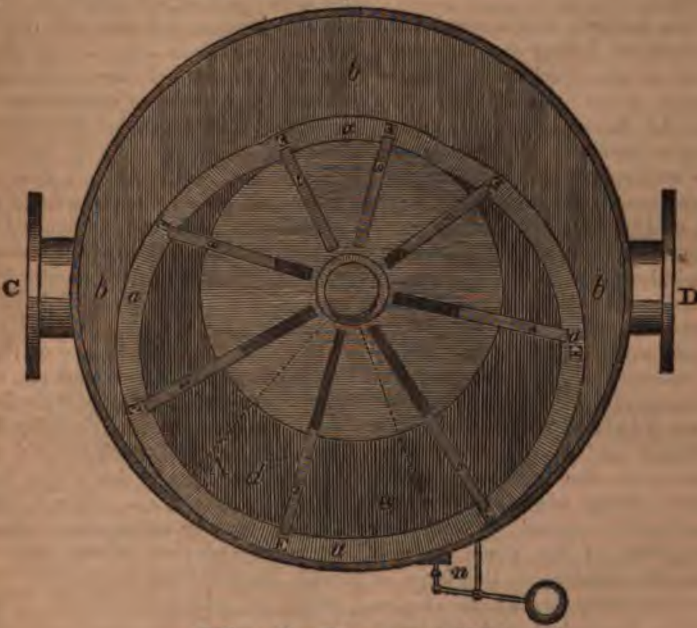
MECHANICS' MAGAZINE.

" For such the bounteous providence of Heaven,
In every breast implanting this desire
Of object new and strange, to urge us on
With unremitted labour to pursue
Those stores, that wait the ripening soul,
In Truth's exhaustless bosom."

No. XXVII. *Saturday, 3d July, 1824.* Price 3*d*.

ROTATORY STEAM ENGINE.

Fig. 1.



[*For Fig.* 2, *see page* 424.]

Fig. 3.

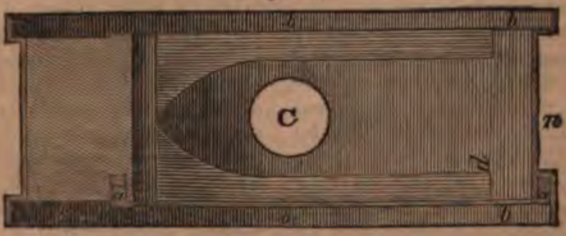


Fig. 4.

ON ROTATORY STEAM ENGINES.

Mr. Editor,—In the 10th No. of your Magazine, you have given a description of a Rotatory Steam Engine, which I think may be considerably improved. Whether the following proposals may be reckoned improvements or not, I leave you and your readers to determine.

It is evident, that a vessel filled with steam, having the same pressure, as described in the former engine, when opened, would allow the steam to expand until it became equal to the pressure of the atmosphere, at which instant, if the vessel was closed, and a jet of cold water admitted to condense the remaining steam, there would be as good a vacuum formed as if the whole steam had been condensed; and, at the same time, would not require so much water to condense it; and were a valve, opening outwards, (as represented in fig. 1,) placed at *n*, between the valves 2 and 3, so as to allow a portion of the steam to escape before it is admitted into the condenser, instead of allowing the whole of the steam to pass into the condenser, the force of the air pump would not be so greatly diminished, and the steam that escaped might be employed to heat the cabin of the steam boat, or any other useful purpose.

By the construction of the former engine, the steam would escape through the valve *n*, which is prevented, in this model, by having eight valves instead of six: and by placing the valve *n*, distant about an eighth part of the circumference of the cylinder, from the point *d*, where the steam begins to act on the valves, because, if placed nearer the boiler, it would be liable to the same objections as if there were only six valves, and if placed nearer the condenser the steam would not have time to expand.

What I would next propose is to have the piece of brass, in fig. 1, No. X., taken away, and small springs placed under each of the valves, which by this means would be kept close to the inside of the fixed cylinder, and also the rings *y*, *y*, (in fig. 2, No. X.,) kept close to the outside of the revolving flanches 5, 5, 5, 5; by spiral springs placed in the thick part of the cover, *e*, *e*, *e*, *e*, might be removed, and in one end of the cylinder a groove turned, in which should be fitted a metallic ring *a*, *a*, *a*, *a*, (figure 1.) This ring is kept close to the inside of one of the revolving flanches, by means of some hemp placed in the groove under it; the other end of the cylinder may be turned of the same shape, with this difference, that instead of the groove with the ring, the opposite revolving flanch might be made to touch the end of the cylinder, and by this means the outside covers *e*, *e*, *e*, *e*, (in fig. 2, No. X.,) may be taken away. Fig. 1, is an end view of the engine, with the revolving flanch, (fig. 2,) taken off, where the grooves, 1, 2, 3, 4, &c. receive the valves 1, 2, 3, 4, &c. D, is the eduction pipe, and *n*, the valve, with a weight attached to it, in order to keep it close to the cylinder; the mechanism of which may be understood by the figure. Fig. 3, is a vertical section of the cylinder, with the revolving parts taken out, where the letters in this figure correspond with fig. 1. C, is the steam pipe, *b*, *b*, *b*, *b*, are the spaces in which the revolving flanches work; *a*, *a*, *a*, *a*, the ring cut through, which shows the packing below the ring, and the manner in which the ring is fixed into

the cylinder. Fig. 4, is one of the valves, the two pieces E, E, project a little over the edge of the cylinder, to prevent the steam from escaping through the grooves, (seen in fig. 1 and 2.)—Your's, &c.

J. W.

Lauriston, 6th April, 1824.

ON ELECTRICITY.

(Continued from page 412.)

The insulation of a body is effected by supporting one electric on another, and in this state the power may be retained for a considerable time.

From the circumstance of different electrics presenting the electrical light under different forms, it was at first supposed that since, when brought into contact, these apparently destroyed themselves, they must be different* kinds of electricity in opposition to each other; and from the one having been obtained first from glass, the other from wax, they were distinguished by the name of the Vitreous and the Resinous Electricities.

The celebrated Dr. Franklin denied any difference subsisting between these two, and referred their production to only one agent; *viz.* a fluid highly elastic, which exists in all bodies in natural proportions, and in which, when subjected to certain operations, the body acquires more or less than its natural proportion.

In the one case they are said to be electrified *plus* or positively, in the other *minus* or negatively. Dr. Franklin's system certainly proposes one great advantage in its simplicity, and it affords a very good explanation of the effects of the Leyden Phial. His unwearied assiduity was employed in various ways on this subject, and to him we owe what must have resulted from acute reasoning and accurate observation; the invention of conductors for the preservation of buildings from the *awful devastations* of this *powerful instrument of nature.* The efficacy of his metallic conductors has, after a lapse of seventy years, been demonstrated to be complete in protecting buildings from its destructive effects. But although the application of conducting substances on land is generally judicious, and their advantages are admitted, yet on ship-board where the effects of lightning are most to be dreaded, from the inflammability of the substances of which the ship and stores are usually composed, the introduction of electrical conductors has been lamentably neglected or injudiciously employed. The conductor hitherto employed is a chain of wire, usually kept in a box, and used only when danger is apprehended, which has often been too late.

From these considerations, during the course of last year, a Mr. Harris, a gentleman of Plymouth, was induced to submit a model of a complete mast, furnished with permanent conductors, to the inspection of the Honourable Navy Board, who expressed their decided approbation of the principle, and requested him to exemplify its efficiency by an experiment, which was carried into effect at Plymouth on the 16th September last, with complete success.

The subject is so interesting, that although the description of it is rather long, we subjoin it in the inventor's own words.

" A small cutter, having had a temporary mast and top-mast fi with a copper conductor, acco

to the proposed plan, was moored a-stern a larger vessel; and at the distance of 80 feet from the cutter, a boat was stationed with a small brass howitzer. On the tiller head of the large vessel were placed an electrical machine and an electrical jar, with the outer coating of which a line was connected, having a metallic wire woven in it; this line being carried out of the starboard window of the ward-room, terminated in an insulated pointed wire in the immediate vicinity of the touch-hole of the howitzer; a similar line was passed from the larboard window, which communicated with the mast head of the cutter, and at the termination of the bolt through the keel, a chain was attached, connected with another insulated pointed wire in the boat, placed in the vicinity of the touch-hole; the space between the insulated points being the only interval in a circuit of about 300 feet from the positive to the negative side of the jar.

"Some gunpowder being placed in contact with the conductor in the cutter, and the priming in the interval of the insulated points, the jar was charged, and the line attached to the mast head of the cutter being brought into contact with the positive or inside of the jar, a discharge of electric matter followed, which was passed by the line to the mast head, and by the conductor through the powder to the chain in the water, by which it was conveyed to the interrupted communication in the boat, where it passed in the form of a spark, and, discharging the howitzer, returned to the negative or outside of the jar, by the line which led to the starboard window; thereby demonstrating that a quantity of electric matter had been passed through the powder (without igniting it) in contact with the mast of the cutter, sufficient to discharge the howitzer.

"The communication between the keel of the cutter and the positive wire in the boat was then detached, leaving the wire to communicate with the water only; but this interruption did not impede or interrupt the charge, as the discharge of the howitzer was effected with equal success as in the first instance, the water forming the only conductor from the cutter to the boat. In order to demonstrate that a trifling fracture or interruption in the conductor would not be important, it was cut through with a saw, but this produced no material injury in its conducting power."

It is to be hoped that this invention will be speedily acted upon and adopted, especially as, from its simplicity, it can be productive of no trouble, and may be the means of averting those calamities which have not unfrequently occurred.

Much may yet be undiscovered with regard to the nature of this wonderful power, notwithstanding the ingenious and close reasoning, and the great variety of curious and interesting experiments, which have already formed, perhaps only the ground-work, of a regular system with regard to it.

In the hypothetical as well as the practical part of the science, some things are not yet sufficiently simplified, but from the facilities now afforded for making new discoveries in electrical science, farther light may reasonably be expected with regard to some parts of it which certainly are not altogether perfect.

D.

Glasgow, 1824.

ON THE VARIETIES IN THE HUMAN RACE.

(Continued from page 410.)

THERE are two general laws, indeed, which relate to the stature and colour, and which serve to account, in a great measure, for the varieties which occur, though they are not without very considerable exceptions. The stature of the human body is observed to be diminished in proportion as the inhabitants of different countries are situated nearer the pole, and enlarged as they are nearer the equator; and in like manner the skin, but especially the colour of the hair is found whiter as we go farther north, and of a darker hue as we approach to the burning line. With respect to the varieties of the hair, however, there are several contradictory facts, that would seem to indicate the operation of other causes. Among the civilized nations of Europe, the hair invariably becomes of a lighter colour, as we advance toward the north. But among the barbarous nations of Africa, Asia, and America, the same colour of hair is found in climates completely different. While the dark-haired Italian, and the Scandinavian, with his flaxen locks, although belonging to the same race of the human species, exhibit the effects of the action of climate; the Laplanders in Europe, and the Samoides in Asia, have hair as black and as rough as the inhabitants of Mongul, Thibet, and China; a race which originally sprung from the same tribes, as can be shown from various corroborating circumstances. All the negro tribes have woolly hair, indeed, in whatever climate they may be situated. It does not appear that the hair of the Americans present any shades of difference, compared with those that are observable among European nations. These differences might be explained, on the supposition that the nations of the European race, having separated at an early period, occupied countries extremely diversified in regard to climate, and pursued very different modes of living; whilst the Mongul, or negro tribes, in Asia or Africa, must have multiplied at first in a common region, whence they spread themselves, perfectly formed as to these external characters, into the various countries which they now inhabit. This explanation, however, does not admit of being so closely applied to the case of the American tribes, unless we were to suppose that the new continent had been peopled in different places, and at different times, by colonies originally from the old world, a circumstance which cannot be admitted from the very recent discovery of its existence; hence, some more satisfactory reason must yet be found for the solution of these difficulties.

The varieties in the form of the cranium, or skull, seem to be of more importance than all those which have yet been mentioned at the same time, since the researches of phrenologists have demonstrated that the external configuration of the cranium depends upon the form of the brain, it can scarcely be supposed that the diversities in a substance so soft and susceptible of every form, presents a character in any case unequivocally marking a diversity of species. The form of the cranium is asserted by the phrenologist to depend as much as the physiognomy upon the moral character of individuals; and that though it is impossible to assign to every passion, and to every faculty, a separate organ in the brain, yet it is certain that men of great talents and of strong passions, have the head more varied with bumps

and protuberances than the multitude. Another fact is, that in those nations, the individuals of which most nearly resemble each other in character, and which have been least mixed with other tribes, the skulls appear to have been cast in one common national mould. When we see the head of one Hindoo, we see the heads of the whole nation; on the contrary, in Europe, where the characters of individuals vary extremely, we find skulls of every form, even the most remote from what we reckon the regular shape.

Independently of this general cause, to which should be added the effects of food and climate, the form of the head is frequently modified by artificial means. A pressure continually applied for a great number of years, much more frequently imparts to the smooth bones of the head a peculiar form, which becomes even national at last. This effect is sometimes produced by the manner in which some nations place their children in the cradle, and sometimes by the pressure of the hand long and carefully applied. It is related of the Germans, some centuries back, that they had the head flattened behind, and enlarged at the sides, because they were always laid on their backs whilst in the cradle. The Belgians, on the contrary, who were accustomed in infancy to sleep on their sides, were remarkable for the length of their heads. The American savages, from South Carolina to New Mexico, have all of them the skull depressed, because they place their children in the cradle in such a position, that the crown of the head, which is placed upon a bag filled with sand, supports almost the whole weight of the body. A practice prevalent in ancient as well as in modern times, was to bring the head of the new-born infant to a national form, by means of bandages, different instruments, and the pressure of the hands. This custom, barbarous as it may seem, prevailed formerly, and still continues among the inhabitants of several parts of Germany; among the Belgians; the French; in several districts of Italy; among the Islanders of the Grecian Archipelago; the Turks; the ancient inhabitants of the coast of the Euxine sea; it prevails to this day among the inhabitants of Sumatra, and other islands in the East Indies; in America and Nootka Sound; among the Chactes; the Georgians, the Wacsaws of Carolina; the Carribbees; the Peruvians, and Negroes of the Antilles. This practice, indeed, was forbidden in Spanish America by the decree of a national council. This fact being established by the testimony of travellers of unexceptionable authority, it only remains now to ascertain whether the form of the head obtained by these means, becomes, after a long series of generations, natural and hereditary.

ON THE USE OF PERFUMES FOR PREVENTING MOULDINESS.

By John MacCulloch, M. D. F. R. S. &c.

There are many cases of daily occurrence, in which the growth of those minute vegetables that constitute mouldiness, is a very troublesome inconvenience.

I do not pretend to account for the mode in which perfumes act in producing this effect; nor do I know the limitations with respect to these; but I have found it hold good with all the essential oils that I have tried, and that even when used in a very minute quantity.

Ink, paste, leather, and seeds,

are among the common articles which suffer from this cause, and to which the remedy is easily applicable. With respect to articles of food, such as bread, cold meats, or dried fish, it is less easy to apply a remedy, on account of the taste. Cloves, however, and other spices whose flavours are grateful, may sometimes be used for this end; and that they act in consequence of this principle, and not by any particular antiseptic virtue, seems plain, by their preventing equally the growth of those minute cryptogamous plants on ink, and other substances not of an animal nature.

The effect of cloves in preventing the mouldiness in ink, is indeed generally known; and it is obtained in the same way by oil of lavender, in a very minute quantity, or by any other of the perfumed oils.

To preserve leather in the same manner from this effect, is a matter of great importance, particularly in military store-houses, where the labour employed in cleaning harness and shoes is a cause of considerable expense, and where much injury is occasionally sustained from this cause. The same essential oils answer the purpose, as far as I have had an opportunity of trying effectually. The cheapest, of course, should be selected; and it would be necessary to try oil of turpentine, for this reason.

It is a remarkable confirmation of this circumstance, that Russian leather, which is perfumed with the tar of the birch-tree, is not subject to mouldiness, as must be well known to all who possess books thus bound. They even prevent it from taking place in those books bound in calf near to which they happen to lie. This fact is particularly well known to Russia merchants, as they suffer bales of this article to lie in the London docks in the most careless manner, for a great length of time, knowing well that they can sustain no injury of this nature from dampness, whereas common curried leather requires to be opened, cleaned, and ventilated. Collectors of books will not be sorry to learn, that a few drops of any perfumed oil will ensure their libraries from this pest.

I had commenced some trials on wood on the same principle, with the view of preserving it from what is called the dry-rot, and, as it seemed to me, with effect. A cheap oil, of course, would be required for operations so extensive as this.

The next substance that I shall point out is paste, which is a very perishable article. Alum, which is used by the book-binders, although it preserves that most necessary substance longer than it would remain useful without it, is not very effectual. Rosin, sometimes used by shoemakers, answers the purpose better, and appears to act entirely on this principle. It is, however, less effectual than even oil of turpentine. Lavender, and the other strong perfumes, such as peppermint, anise, and bergamot, are perfectly effectual, even in a very small quantity; and paste may thus be preserved for any length of time.

Those who have frequent occasion to use paste for their labels in very small quantities, and where the trouble of thus making it on every fresh occasion is inconvenient, will be glad to know that this useful article may be made to keep, even for years, always ready for use, and subject to no change.

That which I have long used in this manner is made of flour, in the usual way, but rather thick, with a proportion of brown sugar, and a small quantity of corrosive sublimate. The use of the sugar is to keep it flexible, so as to prevent its scaling off from smooth surfaces; and that of the corrosive sublimate, independently of preserving it from

insects, is an effectual check against its fermentation. This salt, however, does not prevent the formation of mouldiness. But as a drop or two of the essential oils above mentioned is a complete security against this, all the causes of destruction are effectually guarded against. Paste made in this manner, and exposed to the air, dries without change to a state resembling horn; so that it may at any time be wetted again, and applied to use. When kept in a close-covered pot, it may be preserved in a state for use at all times.

This principle seems also applicable to the preservation of seeds, particularly in cases where they are sent from distant countries by sea, when it is well known that they often perish from this cause. Dampness, of course, will perform its office at any rate, if moisture is not excluded; yet it is certain, that the growth of the vegetables which constitute mould, accelerate the evil; whether by retaining moisture, or by what means, is not very apparent. This, in fact, happens equally in the case of dry rot in wood, and, indeed, in all others where this cause operates. It is a curious illustration of the truth of this view of a remedy, that the aromatic seeds of all kinds are not subject to mould, and that their vicinity prevents it in others with which they are packed. They also produce the same effect daily, even in animal matters, without its being suspected. Not to repeat any thing on the subject of cookery, I need only remark, that it is common to put pepper into collections of insects or birds, without its having been remarked, that it had the same power of keeping off mould, as of discouraging or killing the *ptinus omnivorus*, or other insects that commit ravages in these cases.

In concluding these hints, I might add, in illustration of them, that gingerbread, and bread containing carraway-seeds, is far less liable to mouldiness than plain bread. It will be a matter worthy of consideration, how far flour might be preserved by some project of this kind. —*Phil. Journal.*

Fig. 2.—For description, see page 418.

DESCRIPTION OF VETTIE'S GIEL.

A Scene in Bergen-Stift, in Norway. By the Rev. U. F. Borgesen.*

"Wherein of antres vast, and desarts wild,
Rough quarries, rocks, and hills, whose heads touch Heaven,
It was my bent to speak."—*Shakespeare.*

I had often heard of this remarkable Giel,† the only passage to a farm, considerable especially for the number of cattle reared on it. From the danger and the difficulty of the way, no clergyman, or other official person had ever visited it. What seems more remarkable, not even the oldest peasant in Farnæs (the nearest district to it) had ever been on the farm of Vettie. Men lived and died in close neighbourhood to it without having ever seen it. Nobody ever repaired thither but those who were the nearest relations of the family who lived on it, who, of course, were in the most isolated situation possible in an inhabited country. My curiosity was much excited. Besides, in order to have a more accurate knowledge of the people and the district, I had made a point to allow no corner of my parish to remain unvisited. The danger itself was a sort of allurement, as it was a triumph to surmount it.

On Sunday, the 12th of June, 1818, after divine service, I set out from my manse in Aardalannex, in company with a number of people who had been at church, to Aardal's Water. This lake is about three-quarters of a mile long, (more than four English miles,) and at the broadest half a quarter (about three-quarters of an English mile,) inclosed on both sides by lofty mountains, which, from their steep and sometimes perpendicularly hanging sides, forbid all approach by land. The lake is thus the only and the common communication between those who live above it and the other parts of the district of Aardal. There were many boats of us in company, the most of which strove with great exertion to row past one another. They are excellent rowers; and this passage to and from church never takes place without this sort of contest, the only object of which is the honour of winning. It is pleasant to witness this contest. Six men, commonly stout young fellows, sit at the oars; the boat darts forward like an arrow; and you may imagine the vigour which is exerted, when the blade of the oar sometimes snaps in the water,—a circumstance which happened to the boat that was striving with ours, and which, in consequence, fell a considerable way behind. But as they had got a reserve oar, which was put out in haste, our boat, which was deeply laden, having about twenty people in her, was quickly overtaken and passed. So soon as the boat you contend with falls a good way behind, or it is perceived that, in spite of all exertion, you are not able to keep up, the strife is over, though it ceases not without some sarcastic jokes on the part of the conquerors. After this, though they still push briskly forward, they go on more equally in company. We pushed on, and were immediately run on the beautiful Farnæs, where the river Utledal, which, by a course of six miles from where it rises in the mountains of Guldbrandsdal, runs through Utledal, Vettie's Giel, Svalemsdal, and Farnæs, empties itself by seven mouths. It was already evening, and pretty dark; I, therefore, took up my night's quarters at the farm-house of Vee, a pretty large farm, which has an in-

* Read before the Wernerian Natural History Society, 31st May, 1823.

† A *Giel*, in Norwegian, means a narrow glen with steep precipices on both sides, the space between filled up by a river. *Vettie's Giel is several Norwegian miles in length.*

teresting situation on the south side of the river Utledal, not far from Farnæs. There my appointed guide was already waiting for me, a houseman (a sort of subtenant in Norway), who was well acquainted with the family at Vettie. We set out on our road early in the morning, and as this was at first over fine even plains, we mounted on horseback. In the neighbourhood of Vee we passed a mighty water-fall, which, from a side dale called Rösdale, rushes down in one fall of 150 fathoms. Farther east is Valdersdal, so called, because in a stretch of 4 miles, (about 27 English,) it goes up to the mountains of Valders. Through this dale runs the river Thya, coming from the lake Thya, which here descends in a large fall, forming three cascades. Over its mouth is carried a bridge. A little farther on in the vale, on the other side of Utledal River, the course of which we follow the whole way, you see a rocky mountain called Moekamp, lying east and west, as if it were sunk between the far higher mountains on each side. Round the foot of this lie a couple of farm-houses, and several housemen's places. From the River Thya you come on a very high sand-hill, under which lies the farm of Moe. When you have toiled up this difficult and very steep hill, you come to Sualem-hill, a little mountain-ridge lying east and west, and consisting of entirely naked, slippery rocks, on which it is both difficult and dangerous to ride. You now come to the fine plain land of Sualem, which, of considerable extent, stretches on to the farm of Jelde. You have here got about half a mile from Farnæs, and you begin to perceive that the Giel is near.

Nature now assumes a severe character; her smile totally vanishes; the dale contracts itself closer together; the black mountain masses tower higher up on both sides, casting abroad their melancholy shadows. Before you come to the farm-house of Jelde, you pass a bridge over the River Jelde, which, coming from a very high pasture-glen belonging to the farm, gushes down in a fall of about 200 fathoms. Every thing is gigantic and threatening. It is Nature's grand style. Small objects disappear, and the heart beats with the anticipation of approaching danger. At Jelde, you do well to dismiss your horse, and trust to your own legs. It will now, too, be of importance to provide yourself with an additional guide. Farmer Civind offered to accompany me; but as he could not himself go with me the whole way, he made his servant likewise be of the party. I had thus three companions well accustomed to this road, and, therefore, on their own part, altogether unconcerned about dangers which were familiar to them, but who could very well enter into the feelings of a person in a different mode of life, who, for the first time, trod a path the like to which he had never seen, nor could conceive. When Civind had found his axe, which he had long to look about for, and the use and necessity of which I had afterwards to learn, to my terror, we all set out.

At a short distance from the dwelling-house of Jelde farm, this frightful way begins. The entrance to the Giel is altogether worthy of it. You climb up over the hill of Jelde. This is a projecting outcorner of the mountain, consisting of granite, which, with an inward bend, hangs over the river which washes its foot. It is thus impossible to find a lower road, as this precipice forms the bank of the river. It is a severe exertion to climb this steep and difficult path

a height, and constantly on ık of precipices.

probably this hill which has e height of the path in the self; for, otherwise, you see ion why it should have been at such a height, on the this frightful wall of rock, e person who falls over it, dashed to pieces before he the surface of the water. you have reached the top of ll, you turn round to the nd, and enter into the Giel by a bridge of pliant trunks s, laid over with birch-bark, f and gravel, that all swing your feet. The mountain ngs a little over the passenead, and you willingly in- it, as to a friendly support, d seeing, and, if possible, to hinking of the abyss you are g over, but of which, the thrown down by the motion bridge, is all the way putting mind. You are now in the Traveller, God be with

path here is not broader at a person can just stand on both feet beside each other. imes you have only room for ot; nay, at times, from the y of loose earth and small which you may well suppose quently tumbling down here, vering the whole path, you place at all to stand on, but with your foot, in a manner, out such a place in these naterials, which here lie over face of the whole precipice, per part of which forms a harp angle with your body, the part below approaches ully near to a perpendicular

ut half a quarter of a mile the Giel, on the north side of er, high up towards the sum- *the mountain*, there opens on you, a cross valley, the remarkable Afdal. The houses on a farm which is here, stand on so steep a slope, that, while the under-beams rest with one end on the ground, to have a horizontal position, they must be supported on the opposite side, by a wall of 4 ells in height (8 feet English.) The fields, too, lie so steep, and so near the fearful precipice, that no person unaccustomed to it, would venture to set a foot on them. And when, from the Giel, you see their grass fields, which hang rather than lie over the deep below, and which are every year mowed with a kind of scythe wrought by one hand, you can scarcely conceive the desperate courage which coolly plies its task where an abyss seems open to swallow the fool-hardy man.

A little above the dwelling-house, is a piece of ground, tolerably flat; and, when you enquire why they did not rather build there, you are told that it is impossible to build there, from the quantity of snow that tumbles down on it. Through this dale runs the river Afdal, which rises from the summits of the mountains called the Young Harlots.* It runs past the house, at a distance of about 30 ells; and, at about 150 ells from it, with a noise like thunder, tumbles over the precipice in a tremendous fall. The violence of this, with the agitation produced by its rushing over, is such, especially in summer, that the house continu-

* These are reckoned among the highest mountains in Bergen Stift, higher than Galetind, the height of which is given at 5514 feet above the sea. They take their name from a singular tradition in the country. A marriage party, who were all very wicked persons, on their way to church, were changed by the wrath of Heaven, into these rocky summits. There are seven of them, of which the bride and bridegroom are the highest.

ally shakes; and every fluid which stands in an open vessel exhibits a constant tremulous motion. The walls and the windows which are next the river are always wet, from the vapour ascending from the fall. They told me that this fall was 200 fathoms high; and, when you look down to the abyss below, and then raise your eye to where the river issues from this lofty vale, you can scarcely call it in question. Beside the fall in the hard granite precipice which it washes, they have mined a rut, I cannot call it a way, though it serves for one, broad enough for one man; or, at most, a little well-trained horse, but not beside one another, to go upon it.

This rut, the roof of which is just so high that a grown-up person can stand upright in it, is the only way to the farm-house, till you get up to a considerable height. It reaches not, however, the whole way. There is a gap, which is filled up by pieces of timber, joined together, of 6 or 7 ells in length, one end of which rests on this rut, the other on a projection of the mountain, which likewise serves as a support to a bridge which goes over the fall. In these pieces of timber are cut notches, which serve for steps; and in going up these notches, while you see through the timbers the foaming cataract under you, and are involved in its mists, he must be a native of Leirdal who does not then feel that his life hangs on a few inches of slender tree. It is a matter of course, that neither this wooden path, nor the bridge itself, nor the rut in the side of the rock, are provided with any kind of rail or defence. A Leirdaller knows not the name, has not the conception of giddiness. He falls as other people do, although he stands where they would fall: he is dashed to pieces, like them: but this comes from his inconceivable rashness, and from his not having wings. Of the ten years I have now been here, not one has passed without instances of persons being killed by falling over precipices. This is one of the common modes in which people die, and it awakens no particular sensation. They believe, however, that the spirits of these persons go about after death, and they have a particular name by which they distinguish them from other ghosts, When the farmer in Afdal brings any thing to his house, when he comes to the river he must take it off the horse, and letting him go loose before, he and his servants must carry every thing upon their backs.

(*To be continued.*)

Dr. BUCHAN'S REMARKS ON RIVER AND SEA BATHING.

People are apt to imagine that the simple element of water can do no hurt, and that they may plunge into it at any time with impunity; in this, however, they are much mistaken. Apoplexies have been occasioned by going into the cold bath, fevers excited by staying too long in it, and other maladies so much aggravated by its continued use, that they could never be wholly eradicated. Immersion in cold water is a custom which lays claim to the most remote antiquity; indeed it must be coeval with man himself. The necessity of water for the purpose of cleanliness, and the pleasure arising from its application to the body in hot countries, must have very early recommended it to the human species. Even the example of other animals was sufficient to give the hint to man. By instinct many of them are led to apply cold water in this manner; and some, when deprived of its use, have been known to languish, and even to die.

The cold bath recommends itself in a variety of cases, and is peculiarly beneficial to the inhabitants of populous cities, who indulge in idleness and lead

itary lives. In persons of this des-ion, the action of the solids is al-too weak, which induces a languid lation, a crude indigested mass of ours and obstructions in the capillary ls, and glandular system. Cold r, from its gravity, as well as from nic power, is well calculated either bviate or remove these symptoms. ccelerates the motion of the blood, notes the different secretions, and permanent vigour to the solids.— all these important purposes will be essentially answered by the appli-n of salt water. This ought not to be preferred on account of its rior gravity, but likewise for its ter power of stimulating the skin, ch promotes the perspiration, and ents the patient from catching cold. t is necessary, however, to observe, cold bathing is more likely to pre-than to remove obstructions of the dular or lymphatic system. Indeed, n these have arrived at a certain ht, they are not to be removed by means, In this the cold bath will aggravate the symptoms, and hurry unhappy patient to an untimely grave; therefore, of the utmost importance, ious to the patient's entering upon use of the cold bath, to determine ther or not he labours under any inate obstructions of the lungs, or r viscera; and where this is the cold bathing ought strictly to be ibited.

n what is called a plethoric state, or great fulness of the body, it is like-dangerous to use the cold bath, bout due preparation. In this case e is great danger of bursting a blood el, or occasioning an inflammation of brain, or some of the viscera. The pre-ion is the more necessary to citizens, ost of them live full, and are of a s habit. Yet, what is very remark-these people resort in crowds every on to the sea-side, and plunge into water without the least consideration. doubt they often escape with impu-; but does this give a sanction to practice? Persons of this descrip-ought by no means to bathe, unless body has been previously prepared suitable evacuations.

Another class of patients, who stand ieed of the bracing qualities of cold er, is the nervous. Yet even those ons ought to be cautious in using the bath. *Nervous people* have weak bowels, and may, as well as others, be subject to conjestins and obstructions of the viscera; and in this case they will not be able to bear the effects of cold water. They ought to begin with the temperate bath, and gradually use it cooler, till at length the coldest proves quite agreeable.

Wherever cold bathing is practised, there ought likewise to be tepid baths, for the purpose above mentioned.

The ancient Greeks and Romans, we are told, when covered with sweat and dust, used to plunge into rivers without receiving the smallest injury. Though they might escape danger from this imprudent conduct, yet it was certainly contrary to sound reason. Many robust men have thrown away their lives by such an attempt. We would not, however, advise patients to go into the cold water when the body is chilly; as much exercise, at least, ought to be taken, as may excite a gentle glow all over the body, but by no means so as to overheat it.

To young people, and particularly to children, cold bathing is of the utmost importance. It promotes their growth, increases their strength, and prevents a variety of diseases incident to childhood. Were infants early accustomed to the cold bath, it would seldom disagree with them, and we should see fewer instances of the scrofula, rickets, &c. which prove fatal to many, and make others miserable for life.

It is, however, necessary here to caution young men against too frequent bathing; as many fatal consequences have resulted from the daily practice of plunging into rivers, and continuing there too long.

The most proper time of the day for using the cold bath is no doubt the morning, or at least before dinner, and the best mode that of quick immersion. As cold bathing has a constant tendency to propel the blood, and other humours, towards the head, it ought to be a rule always to wet that part as soon as possible. By due attention to this circumstance, there is reason to believe that violent head-aches, and other complaints which frequently proceed from cold bathing, might be often prevented.

The cold bath when too long continued in, not only occasions an excessive flux of humours toward the head, but chills the blood, cramps the muscles, relaxes the nerves, and wholly defeats the

intention of bathing. Hence, by not adverting to this circumstance, expert swimmers are often injured, and sometimes even lose their lives. All the beneficial purposes of cold bathing are answered by one immersion at a time; and the patient ought to be rubbed dry the moment he comes out of the water, and should continue to take exercise for some time after.

When cold bathing occasions chillness, loss of appetite, listlessness, pain of the bowels, a prostration of strength, or violent head-ache, it ought to be discontinued.

MISCELLANIES.

THE SCRAP GATHERER;

OR,

A Selection of Facts worth knowing.

" Science is not science till revealed."

No. 15.—*Different Orders of Gothic Architecture.*—There are *three* orders of this style, each of which is essentially characterised by the degree of inclination of the lines forming the pointed arch; consequently, are as plainly distinguishable from one another as the orders of the Grecian architecture, and having their respective members, ornaments, and proportions.

In the *first order*, the arches are very acute, and the pillars for the most part heavy and massive, such as are found in Saxon or Norman buildings, but sometimes having a faint resemblance to the clustered columns, groins of simply intersecting ribs, and windows without mullions, or having only a single bisecting one, and ornamented with a single trefoil, quatre-foil, or other simple flower.

In the *second order* are exhibited arches, forming an equilateral triangle, clustered columns generally formed out of one stone, and having what are called historic capitals, windows magnificently enriched with a variety of ornaments, decorated groins, mullions reaching to the bottom of their story, shafts of the main clustre supporting the springers of minute arches, &c. all indicative of a grandeur and freedom bordering on luxuriance, but withal extremely delicate and pleasing.

The *third order* is easily discriminated by its depressed obtuse angled arches, pendant capitals, greatly perforated walls, and an extravagant profusion of tracery and other fanciful decorations, much more calculated to excite surprise and a feeling of perplexity, than to gratify a refined and correct taste.

This order has justly enough been considered as marking the decline of the style.

16.—*Theory of Painting.*—This liberal art has always been honoured and respected, according to the degrees of civilization and refinement to which society has arrived; it stands in the same rank as poetry, has the same object in view—the representation of nature; and, as far as the difference in their modes of operation permits, is conducted on the same principles. Thus paintings, like poetry, comprehends the satirical, the comic, the pastoral, the didactic, the pathetic, the dramatic, and the heroic or grand style; and the rules of composition, of that kind more especially which relates to the representation of men and manners, extend equally to painting and poetry. The great object of both is to convey instruction, or to move the passions, by the representation of some fact, or appearance of nature, according to the end proposed. Thus, in the pastoral, they delight and soothe by the appearance of a fine country; in satire, we see the deformities of vice, or, in her more sportive humours, the follies of mankind exposed and ridiculed; in the tragic, we are moved to pity or horror; and in the heroic, our enthusiasm is kindled by the representation of deeds of glory. Paintings, while they are a source of great happiness to the individual, are, at the same time, highly advantageous to society, in conducing to the refinement of the human mind; for " every argument of sorrow, every object of distress, renews the same soft vibrations, and quickens us to acts of humanity and benevolence," while our minds are likewise opened by it to the contemplation of the beauties of nature, and acquire a higher relish for every thing noble or sublime.

17.—*Theory of Engraving.*—The art of engraving has been of the greatest importance to the fine arts, to which it bears the same relation as printing to philosophy and the sciences; being also to them a powerful auxiliary, by the fa-

cility of illustrations which its graphic delineations and diagrams afford to written language; and, of all imitative arts, not even excepting painting, it has been most subservient to the purposes of general utility, by the facility of multiplying the impressions, and the ease with which they may be preserved. By means of this art, those works of the art of painting—celebrated for their excellencies, the admiration of the scientific connoisseur, and the theme of applause of the enlightened traveller—which would be known only by report, confined for ever to the palaces or churches in which they are shut up, acquire, by multiplying their engraved copies, a perpetuity of existence, and a sure asylum against the injuries of time and violence, and are widely disseminated over distant countries at a moderate expense.

The honour of the invention of copperplate engraving, is said to have been discovered by a goldsmith of Florence, about the year 1460, who, having engraved some figures on a silver plate which he intended to enamel, in order to try the effect of his work, poured upon the plate some liquid sulphur, and the dirt or black, lodged in the crevices, adhering to the sulphur, produced an impression like a pen drawing, and suggested to him the idea of an impression upon paper, in which he ultimately succeeded.

18.—*Theory of Sculpture.*—The province of sculpture is to represent the true form of objects, in all their variety of figure, character, and expression; in the execution of which, she demands the utmost purity of design and conception, and a rigid severity and simplicity of style. The sculptor's art is limited in comparison of others, but it has its variety and intricacy within its proper bounds. Its essence is correctness, and when, to correct and perfect form, is added the ornament of grace, dignity of character, and appropriate expression, this art may be said to accomplish its purpose.

Sculpture, on whatever material it may be executed, comprehends two great classes: *first*, Statues or full figures, and busts, which are either placed in niches in the wall, on the tops of buildings, or insulated, standing on pedestals in public places, gardens, and the like, as well as in the interior decorations of halls, and public and private edifices; and, *secondly*, Works in relievo, wherein the figures are not detached behind from the block on which they are cut. These consist of two kinds, viz. *alto* and *basso relievo*. In the former, the figures, though still attached to the wall or block, have their heads, arms, legs, &c. sometimes completely detached; and, in other examples, though they may have a bold projection from the plane of the block, they are entirely attached to it. Basso relievo is, on the other hand, extremely flat, and little raised from the surface.

19.—*Triumph of Science.*—It was objected to Copernicus, in his own days, that, if his scheme was true, Venus must appear to us with different phases, just as the moon does. "So she would, I believe," replied he, "if we could see her aright." This was a noble guess for the time, and what was proved to be exactly the case, since Galileo has found out new eyes for us.

20.—*Pores of the Human Body.*—The skin of the human body is a very curious object for the microscope. By cutting a thin piece with a very sharp penknife or razor, and applying it to a good microscope, a multitude of small pores will be seen, through which the perspirable matter is supposed to be perpetually transmitted. These are best seen in the under or second skin. There are said to be 1000 pores in the length of an inch, and, of course, in a surface an inch square, there will be 1,000,000, through which either the sensible or insensible perspiration is continually issuing.

If there are 1,000,000 pores in every square inch, the following calculation is made of the number in the whole body. The surface of the body of a middle-sized person is reckoned to contain 14 feet; and, as each foot contains 144 inches, the number of pores will be estimated at $1,000,000 \times 144 \times 14 = 2,016,000,000$, or two thousand and sixteen millions.

In reply to your Correspondent's several queries relating to the steam engine in Cornwall, which I mentioned as being of 600 horse power, I have only to say, that I procured that piece of information from "The London Journal of Arts and Sciences," vol. xi. p. 18, and never having been at Cornwall, nor having any acquaintances in, or from that quarter, cannot take it

upon me to give the particulars he wishes. However, as to this "king of engines" *reality*, no doubt need exist, when taken notice of by such a respectable journal.

The Scrap Gatherer.

ANECDOTE OF HARRISON.

John Harrison, the inventor of the time-keeper, which procured him the reward of the Board of Longitude, was the son of a carpenter in Yorkshire, and assisted his father in the business until he was twenty years of age. Occasionally, however, he was employed in measuring land, and mending clocks and watches. He was from his childhood attached to any wheel machinery; and, when he lay ill in his sixth year, he had a watch placed open upon his pillow, that he might amuse himself by contemplating the movement. Though his opportunities of acquiring knowledge were very few, he eagerly improved every insident for information. He frequently passed whole nights in drawing or writing; and he always acknowledged his obligations to a neighbouring clergyman, for lending him a manuscript copy of Professor Sanderson's Lectures, which he carefully and neatly transcribed, with all the diagrams.

On the reward being offered in the 14th of Queen Anne, for discovering the longitude, Harrison's attention was drawn to the subject; and he began to consider how he could alter a clock, which he had previously made, so that it might not be subject to any irregularities occasioned by the difference of climates, and the motions of a ship. These difficulties he surmounted; and his clock having answered his expectations in a trial attended with very bad weather, upon the river Humber, he was advised to carry it to London, in order to apply for the parliamentary reward. He first showed it to several members of the Royal Society, who gave him a certificate, that his machine for measuring time promised a very great and sufficient degree of exactness. In consequence of this certificate, the machine, at the recommendation of Sir Charles Wager, was put on board a man of war in 1736, and carried with Mr. Harrison to Lisbon and back again; when its accuracy was such, that the Commissioners of the Board of Longitude gave him £500, and recommended him to proceed. He made two others afterwards, each of which were improvements on the preceding; and he now thought he had reached the *ne plus ultra* of his attempts: but in an endeavour to improve pocket watches, he found the principles he applied to surpass his expectations so much, as to encourage him to make his fourth time-keeper, which was in the form of a pocket watch, about 6 inches in diameter, and was finished in 1759. With this time-keeper, his son made two voyages, the one to Jamaica, and the other to Barbadoes; in both which experiments it corrected the longitude within the nearest limits required by the Act of Parliament; and the inventor, at different times, though not without considerable trouble, received the promised reward of £20,000.

PATENT.

To Pierre Jean Baptiste Victor Gosset, of St. John's, parish of Clerkenwell, county of Middlesex, Merchant, for a communication by a foreigner residing abroad, of an invention of a combination of machinery for producing various shapes, patterns, and sizes, from metals, or other materials capable of receiving an oval, round, or other form.—Sealed at Edin. 10th March, 1824.

NOTICES TO CORRESPONDENTS.

We have received W. C.'s explanation, in which he confesses his mistake of substituting 19 for 38. We wonder what sort of eyes he has got, as he has made this blunder no less than four times in his communication. We cannot insert his corrected method, nor his new method of calculating compound interest, as the interest question has lost its *interest* with the most of our readers, and has already occupied too much of our room. Y.'s sketch of the life of James Watt will, perhaps, appear in our next. "Two or three young students" will perceive their query is not inserted; we wish they would employ their ingenuity in solving, rather than proposing problems. Our "Scrap-Gatherer" is falling in with immensely heavy *scraps*;—"clustered columns, capitals, and arches," are no *light* matter. We hope his future communications will be of a more attractive nature.—"Scotus," from Paris, and "Philomechanicus," from London, will be inserted next week.

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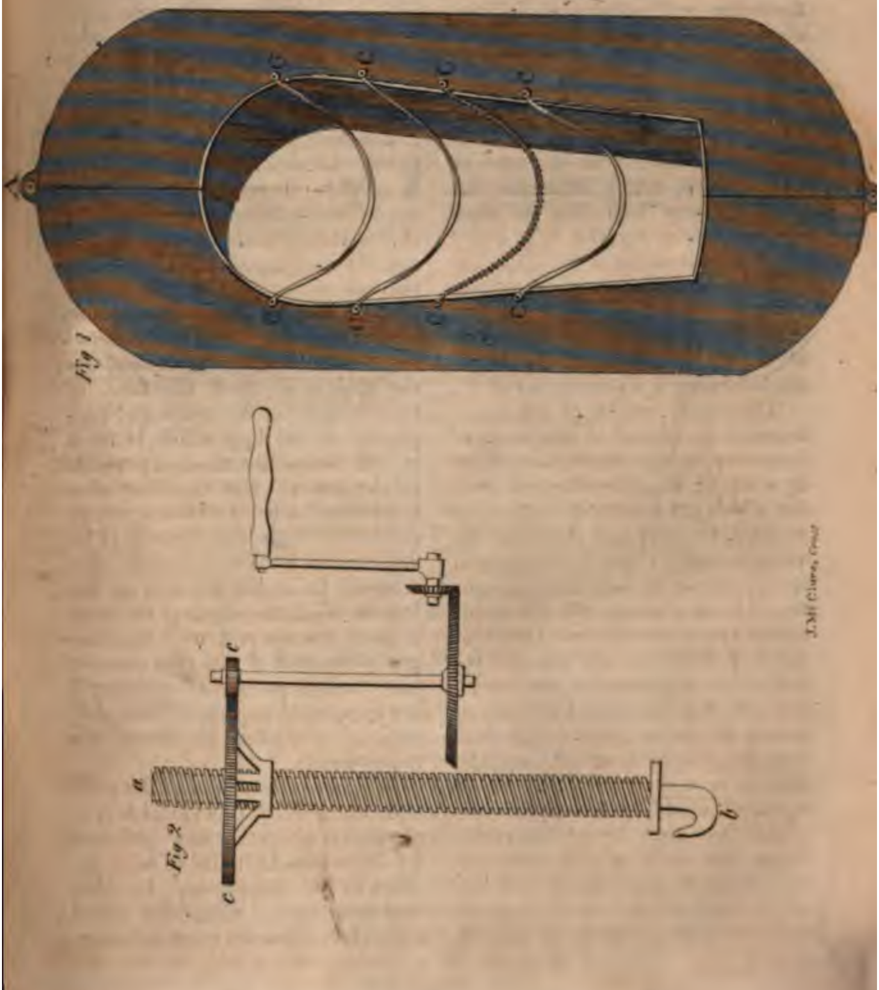
THE GLASGOW
MECHANICS' MAGAZINE.

"High through mid-air, *here*, streams are taught to flow;
Whole rivers, *there*, laid by in basons, sleep.
Here, plains turn oceans; *there* vast oceans join,
Through kingdoms channell'd deep from shore to shore!
And chang'd creation takes its face from man."—*Young*.

No. XXVIII. *Saturday*, 10*th July*, 1824. Price 3*d*.

Mr. ROBERTSON's MACHINE FOR FLOATING VESSELS UP THE RIVER CLYDE.



Mr. ROBERTSON's MACHINE FOR FLOATING VESSELS UP THE RIVER CLYDE.

Sir,—I beg leave to present to your readers a description of Mr. Matthew Robertson's contrivance, for floating ships up and down navigable rivers, which are not of sufficient depth to allow this to be done without assistance.

The principle of it is to diffuse the weight of a loaded ship over a greater surface of water, by mechanical means, than her own configuration will admit of; and its object is to diminish her draft of water, so as to enable her to be transported through a river so shallow as to be of itself wholly inadequate for this purpose. Mr. Robertson has constructed a model of his machine, which illustrates the principle very well; but he does not presume to say, that in it, every thing is as it ought to be upon the large scale. There is, doubtless, room for many improvements, which time and experience can alone suggest; but, such as it is, the following is a description of it:

The model consists of a flat-bottomed float, formed of two pieces of carpentry, which are fixed together by a strong hinge at the one end, but which are loose at the other extremity, in order that they may diverge to admit the ship into an open space, situate in their common centre. The ship having sailed into this vacant space, the expanded arms, or sides of the float, are brought together, so as to enclose the vessel, and are then fastened by means of strong clasps, or bolts. The float now has become one body, and the ship is in a situation ready to be operated upon by the apparatus, which falls next to be described. Upon the deck of the float are erected four or more pairs of screws, which are furnished with hooks at *their lower* extremities, to receive the ends of as many chains which pass beneath the bottom of the ship, and which have the effect of raising her out of the water, when the screws to which they are attached are elevated. The screws are fixed to a strong railing upon the deck of the float, and are wrought by a series of wheels and pinions, which will be better understood by turning to the plate, fig. 2. than they can be by any written explanation. It may be observed, however, that the power required to elevate a ship of 400 tons burthen, may, by means of this apparatus, be so divided, that a few pounds weight applied to each handle, or lever, will effect it. When the screws are wrought up, by men turning the handles, the chains closely embrace the bottom and sides of the ship, sustaining a portion of her weight, and raising her to any height in the water, which her draught and the shallowness of the river jointly require. As the ship is elevated, the float, of course, sinks in the compound proportion of the load which is upon it, and the surface which it presents to the water. But the float after being thus loaded with a ship, draws so little water in consequence of its flatness and breadth of bottom, that a vessel twice the burthen of the largest which the depth of the river of itself can convey, may be transported through it with the greatest ease; and the means of effecting it are apparently so simple, that they may be entrusted to almost the rudest hands.

It is not pretended that the principle upon which this model is constructed is altogether new, although I believe it to be quite so with respect to Mr. Robertson. In Holland and Russia, a machine called a camel, constructed upon the same,

or a similar principle, has been long in use for the purpose of transporting ships over bars which occur in their navigable rivers. It was invented in Holland by the famous De Witt, for raising or lifting ships to bring them over the Pampus, which is situate at the mouth of the river Y, where the shallowness of the water hinders large ships from passing; and thence a model of it was carried to Russia by Peter the Great, where camels are still employed for lifting large vessels over the bar, in their passage from Petersburgh to Cronstadt.

Whether Mr. Robertson's machine is, or may be made, superior to the camel; or whether it is applicable to the carrying of large ships up and down the Clyde, are questions of serious importance at the present moment, and deserve to be duly considered before the determination to deepen that river, at an enormous expense, be finally taken.—I am, Sir, your's, &c.

W. M.

631, Argyle-Street.

Description of the Plate.

Fig. 1, the Float; A, its jointed end; B, its open end, fixed by eyes and bolts; C C C C, the chains, which pass beneath the ship, having rings placed upon the hooks of the screws, of which one is represented at B, fig. 2. Fig. 2, the apparatus for raising a ship; *a*, the screw; *b*, the hook at its lower end for attaching the chain; *c c*, wheels connected with pinions and a lever for working the screw.

SKETCH OF THE LIFE OF JAMES WATT.*

JAMES WATT was born at Greenock, in the year 1736, of a family said to be long distinguished for their mathematical genius. His father was an active and ingenious merchant of that place, and was one of its Magistrates for many years. His eldest son, the subject of our present notice, was prevented from deriving much benefit from the schools of his native town, by an extremely delicate constitution, which adhered to him through life. This is indeed one of those predisposing circumstances, that scarcely ever fail in exerting a powerful influence over the future fortunes of the individual; for how many of the most eminent artists, poets, and philosophers that have adorned mankind, have been indebted to this seemingly unfortunate incident for that depth of reflection, and that predilection for particular studies that have afterwards immortalized their names! Pope was forced, by the delicacy of his constitution, to look for enjoyment only in the retirement of domestic life; Pascal, Fontenelle, Samuel Johnson, and a host of other illustrious men, have found their only relief from the pains of disease in the excitation of philosophical studies. In later times, the illustrious examples of Scott and Byron are well known to all, and confirm the assertion of many ingenious philosophers who have maintained, that occasional defects and weaknesses of the physical frame are amply compensated by the grasp of mind and developement of genius which study, and the reflective habits consequent on retirement, unfold to the world. We feel convinced that those intensely studious habits that distinguished Watt during his long and arduous career, may in a great measure be attri-

* In the Supplementary Number which will be published next week, there will be given an elegant Portrait of this celebrated Mechanic, along with the title-page and index for the first volume.

buted to the weakness of his constitution in early life.

At the age of eighteen, Watt went to London for the purpose of learning the business of a mathematical instrument-maker, and during a stay of twelve months, made great proficiency in every branch of mechanical art. Some time after his return, in the year 1757, when he was no more than twenty-one, he was appointed *Mathematical Instrument-maker to the University of Glasgow*, at all times celebrated for the talent and reputation of its professors, and at that time adorned by such illustrious names as Simpson, the restorer of ancient Geometry, Adam Smith, the founder of Political Economy, and Black, the able coadjutor of Priestley, Scheele, and Lavoisier in erecting the noble fabric of modern Chemistry. It was during his residence in Glasgow, in the year 1763, that Mr. Watt was employed by the Professor of Natural Philosophy to repair a model of Newcomen's Steam Engine. The difficulty he found in supplying the engine with steam, first suggested to him the idea of a *separate condenser;* and, by means of a course of experiments, he was enabled to ascertain the exact quantity of *heat* consumed in evaporation. It would not suit the limits of this sketch to enumerate the various methods he adopted in bringing the engine from one improvement to another, the mechanical ingenuity he displayed in varying the forms and materials of the different pieces of his complicated machinery, nor the philosophical results that he established by his numerous and well conducted experiments. It may be sufficient to state, that scarcely any one of his improvements could be attributed to chance or accident; all those changes that re-modelled the steam engine are solely to be ascribed to his practical skill as an artist, and to his profound acquaintance with the sciences of Chemistry and Mechanics. Never were combined in one individual such a union of sagacity, ingenuity, and science.

In the year 1765, Mr. Watt entered into partnership with the celebrated Dr. Roebuck, (the founder of the Carron Iron Works,) for the purpose of establishing a manufactory of Steam Engines. This object, however, was not immediately accomplished; partly on account of the embarrassments in which Dr. Roebuck became involved, and partly by the constant occupation that Mr. Watt began to enjoy as a civil engineer. In 1767, he made a survey of a junction canal between the Forth and Clyde; and afterwards made the survey, and superintended the execution, of the canal from the Monkland Collieries to Glasgow. He likewise made surveys of a canal between Perth and Forfar, and a report of one between the Clyde and the Western Ocean, across the isthmus of Crinan. It would be tedious to enumerate the various surveys, plans, and estimates that he undertook for the making of canals, the deepening of rivers, the building of bridges, and the construction of harbours. The last line of country which he surveyed for a canal was that between Fort-William and Inverness, where the Caledonian Canal was afterwards undertaken and accomplished by Mr. Telford.

Soon after his last survey, he accepted the invitation of Mr. Boulton, of Manchester, and settled in England. In 1775, he obtained an extension of the term of the patent he had taken out for his improvements, and the business of manufacturing steam engines was now begun by *Boulton and Watt*. The immense saving obtained by this powerful engine, soon caused its general adoption into the mines of

Cornwall and the rest of England. During the years 1781, 82, 84, and 85, Mr. Watt took out a number of patents for successive improvements in mill-work—such as the rotatory motion of the sun and planet wheels, the expansive principle, the double engine, the parallel motion, and the smokeless furnace. The machine was brought to perfection by the application of the centrifugal regulating force of the *governor*. In the whole of these inventions, and the contrivances necessary to give them full effect:—"We are impressed by an union of philosophical research, of physical skill, and of mechanical ingenuity, which has, we believe, no parallel in modern times. The perfection given to the rotative engine soon led to its general application for imparting motion to almost every species of mill-work and machinery, and gave an impulse, unexampled in the history of inventions, to the extension of our manufactures, population, and wealth." In the year 1780, Mr. Watt invented an ingenious *copying apparatus*, for which he took out a patent. Amidst the multifarious concerns of an extensive business, he gave close attention to the new chemical discoveries that were changing the face of science, and was himself a discoverer of several remarkable properties of the *gases*.

In the year 1786, Mr. Watt introduced into this country the new method of bleaching by means of *Chlorine*, (or *Oxymuriatic Acid*,) discovered by M. Berthollet, of Paris. He communicated Berthollet's discovery to his father-in-law, *Mr. M'Gregor*, a bleacher near Glasgow; and he himself gave directions for the proper construction of the necessary vessels, and superintended the first trials that were made. It is unnecessary to add how successful these trials were, and what astonishing advances have been made in manufactures by the discovery.

Besides these more important subjects, there were few practical arts which he did not cultivate and *improve*, and scarcely any with which he was not intimately conversant. Several years of his life were harassed by the necessity of defending his patents against a host of invaders; but the validity of his claims was finally decided by the Court of King's Bench, in the year 1799.

In the year 1800, Mr. Watt retired from business, but constantly continued to interest himself in the progress of science, *literature*, and the arts; and, till the end of his life, was ever ready to give his advice and assistance to others. Notwithstanding a very delicate constitution, by temperance and good management, he reached the advanced age of 84, with faculties unimpaired; when, after a short illness, he expired at Heathfield, in Staffordshire, on the 25th August, 1819.

He was chosen a Fellow of the Royal Society of Edinburgh in 1784; of the Royal Society of London in 1785; in 1806 the degree of *Doctor of Laws* was conferred on him by the University of Glasgow; and in 1808 he was chosen a Corresponding Member, and afterwards one of the Eight Foreign Members of the Institute of France.

On the 18th of June, 1824, a public meeting was held in London for the purpose of erecting a *monument* to the memory of this illustrious man. Few Meetings have been more remarkable for the high rank and distinguished talents of the speakers, or the noble sentiments they expressed. The chairman, Lord Liverpool, announced to the meeting that His Majesty

subscribed £500 towards erecting a monument to Watt. The illustrious President of the Royal Society, Sir Humphry Davy, gave an admirable description of the blessings that had been conferred on the world by his inventions; and the son of his former associate (Mr. Boulton) gave a most interesting account of the astonishing increase in the wealth and manufactures of Great Britain that had been accomplished by his powerful genius.—Far be it from us to imagine that the encomiums bestowed even by such men as the Earl of Liverpool, Sir Humphry Davy, Mr. Huskinson, Sir James Mackintosh, Mr. Peel, and Mr. Brougham, could add splendour to the name of Watt:—but we cannot but express our highest satisfaction at seeing such eminent statesmen coming forward as the representatives of the public voice, and paying the grateful tribute of national admiration to his memory.

The wonders that have been accomplished by the genius of Watt, it would be impossible for us to describe in a manner adequate to the subject; but we shall supply this defect by the following graphic sketch from the pen of Francis Jeffrey:—

"In all that is admirable in the structure, or vast in the utility of the steam engine, he (Watt) should rather be described as its inventor, than as its great improver. It was by his inventions that its action was so regulated as to make it capable of being applied to the finest and most delicate manufactures, and its power so increased as to set weight and solidity at defiance. By his admirable contrivances, it has become a thing stupendous alike for its force and its flexibility—for the prodigious power which it can exert, and the ease, and precision, and ductility with which it can be varied, distributed, and applied.—The trunk of an elephant, that can pick up a pin or rend an oak, is as nothing to it. It can engrave a seal, and crush masses of obdurate metal like wax before it; draw out, without breaking, a thread as fine as gossamer, and lift a ship of war like a bauble in the air. It can embroider muslin, and forge anchors; cut steel into ribbands, and impel loaded vessels against the fury of the winds and waves!

"It has increased indefinitely the mass of human comforts and enjoyments, and rendered cheap and accessible, all over the world, the materials of wealth and prosperity. It has armed the feeble hand of man, in short, with a power to which no limits can be assigned; completed the dominion of mind over the most refractory qualities of matter, and laid a sure foundation for all those future miracles of mechanic power, which are to aid and reward the labours of after generations. It is to the genius of one man, too, that all this is mainly owing; and certainly no man ever before bestowed such a gift on his kind. The blessing is not only universal, but unbounded; and the fabled inventors of the plough and the loom, who were deified by the erring gratitude of their rude contemporaries, conferred less important benefits on mankind than the inventor of our present steam engine."

Y.

Glasgow, 28th June, 1824.

ON Mr. GIBSON'S PATENT ELASTIC HATS.

It is always with pleasure that we turn to inventions which receive their birth in our own city.

The invention of Mr. Gibson consists of a flexible and elastic fabric, applicable to a variety of

purposes, but chiefly as a material in the manufacture of hats.

This fabric is made in the following method: Whalebone is split down into long pieces, commonly about the thickness of a hay-straw. This operation is performed by those persons whose business it is to break whalebone down into fibres, like hairs, to be used in the manufacture of brushes. Those long pieces of whalebone are then woven into a very open gauze-like fabric; which, from the nature of its materials, is exceedingly flexible and elastic. This is Mr. Gibson's new patent fabric.

In making hats, this fabric is first shaped properly for the *tip*, and the *sides*, and the edges of it are all bound with cloth, for their preservation. The tip and the sides are then sewed together in the proper shape. The *brim* is now added; which may either be of felt, or of a close fabric, consisting of whalebone and woollen yarn, interwoven alternately. The top and the sides are next covered with a thin cotton cloth. This is water-proofed, and the brim is stiffened; both by the common means employed in making what are called silk hats. Above the whole, the cloth, with the exterior silk upon it, is cemented likewise in the common way.

Such is the method of manufacturing Mr. Gibson's hats; which, for flexibility and elasticity, and especially for lightness, it will not be easy to excel. The brim, being the heaviest part of the hat, makes it sit pleasantly on the head.

When on the subject of hats, we cannot help pointing out some defects, to which, as a covering for the head, we conceive they are subject.

Of these, no small one is the perpendicularity of the sides, or rather we should say, their gradual widening internally; leaving no resting place for the crown of the head, except the crown of the hat, which, according to the present fashion, cannot be reached unless the hat be drawn over the chin. Now, into what an unhappy plight does this ridiculous shape put poor wights, who are furnished in some department with more wit than their neighbours, or who, in other words, have *bumps* on their heads! Not to offend the modesty of any one, in the selection of an eminent example, we shall take *ourself*. Now, it is proper that our readers should know that our *self-esteem* is very small, but that our *concentrativeness* is very large, as all the world has seen, in our bust, in the possession of the Edinburgh Phrenological Society, (*bust No.* 96, *with a mask.*) We appeal, then, is it fair, that because an eminent person, (like ourself,) should possess the faculty of concentrativeness, or, in other words, should have a bump on the back, or any where else of the head; is it fair, we say, that an eminent person, (like ourself,) should, because he is thus endowed, be obliged to adjust his hat, at an average, once every five minutes? The case is pathetic; and, if this should meet the eye of Mr. Martin, we trust that he will introduce a remedy in a clause of his next Bill, respecting cruelty to animals.

But we have yet farther objections to hats. They are commonly air-proof, and, if possible, waterproof. Hence, they allow of no escape to perspiration; and, when enlarged to weaken this effect, they become, as they are at present, huge castles. The helmet of the dragoons, (most elegant, and most military-like, it is true,) affords very little room to the head; which thus it is found to keep in a continued sweat. Those who wear hats must often have found their head in this

state, long before any other part of their body. Nor is the matter mended, if the hat be not water-proof; for the material of hats is of such a nature, that it is destroyed by the admission of water.

The great liability of the external surface of hats to injury, and to the effects of wear, is another important defect.

The best male head-dress used in this country is, beyond all doubt, the Kilmarnock bonnet. It is cheap; it is liable to almost no accident; it stands long and fatiguing wear; it is thick, and keeps out wet; it is porous, and allows perspiration to escape. The universal introduction of this bonnet into the army, instead of the old foraging caps, is one of the most judicious improvements which has been made in the dress of our soldiery. Most happy should we be to see it (especially among the working classes, who are little trammelled by fashion) get, even more extensively than it has, that footing to which it is recommended by its economy, and its surpassing utility. We cannot leave the subject of our bonnet, without adding, that, according to our taste, it is much improved by being all of one colour, and by having a patent-leather front.

There is a kind of cap at present worn, chiefly in the dress of boys, and as a travelling cap; to which, we think, Mr. Gibson's fabric may be advantageously applied. Under a variety of shapes, it is essentially distinguished, by having only a front, without a brim, and by having a very broad projecting tip. Let Mr. Gibson's fabric be employed to make an elastic tip, and likewise that part of the side which it is wished should be upright. Let it all be covered with blue woollen cloth; such of it as covers the tip being water-proofed; but only such of it as covers the tip. Mr. Macintosh's water-proof cloth would answer for this purpose better than any other we know. The advantage of such a cap would be, that by means of Mr. Gibson's fabric, it would be both very light, and not liable to lose its shape; and, by having only the tip water-proofed, it would afford the head protection from rain, at the same time allow perspiration to escape by the sides. A cap, on similar principles, might probably be, with advantage, introduced into the army.

ON THE MEASURE OF FORCE;

With Remarks on Mr. Smeaton's Experiments on this subject.

It is now very generally agreed upon, that the momentum of a moving body, or the force with which it would strike any object at rest, is properly measured by the product of its weight into its velocity. This opinion, however reasonable it may appear to many who have been accustomed to look upon it almost as an axiom, did not attain the ascendancy which it now holds, without being disputed, and there was a very wide difference between it and the other which was brought into competition with it. The dispute first commenced in consequence of Sir I. Newton laying it down in his Principia, as a law of nature, that, "the quantity of motion is the measure of the same, arising from the velocity and quantity of matter conjointly." The jealousy which existed between the British and French philosophers at this time, did not allow any point to pass unnoticed, where there was the least room for criticism. The latter, in this instance, contended, that Sir I. Newton had given an improper measure of momentum, and that the true

measure was the product of the weight into the square of the velocity. This opinion was advocated by Leibnitz, Bernoulli, and others; and one opinion, as might reasonably be expected, was not confined to the philosophers of one country, but there were Englishmen who were convinced of the truth of the French opinion, while there were some on the Continent who still adhered to that of Newton. However different the results might be, which were to be obtained from the different rules in dispute, each was furnished with what appeared to be reasonable arguments in favour of his own hypothesis, and the dispute, perhaps, assumed for a while, the form of many, where the arguments on both sides seem to be balanced, and each can bring forward facts enough in support of his own ideas, while he finds it difficult to refute the arguments of his opponent.

Those who viewed the subject in the same light with Newton, argued that those momenta must be equal which have been produced by the same impulsive power acting for the same interval of time, and that the ratio of two unequal momenta, would be that of the times requisite to produce them by the action of the same impulsive force. Now, gravity is a force which is continually acting, and always with the same intensity; and experiment showed, that the velocity which it produced in any body, was just proportional to the time of its action; but as they went on the supposition, that the momenta generated by the same force, were also in proportion to the duration of its action, it followed that they depended upon the weight of the body and its velocity jointly.

Those, again, on the opposite side of the question, proved experimentally, that if two equal spheres, of unequal densities, were projected into a uniformly retarding medium, so as to sink to the same depth in it, the velocities of projection would be in the inverse ratio of the square roots of the densities, or what amounts to the same thing, the densities, or (as the spheres are equal) the weights, would be proportional to the squares of the velocities. Here, then, were two equal balls penetrating to the same depth, in the same medium, effects which were to all appearances equal; and, if so, they must have been produced by equal momenta; but the momenta could not be equal, unless they depended on the square of the velocity.

Such are specimens of the arguments brought forward by the disputants on both sides, in support of their favourite hypothesis. In the experiment with the balls of unequal density, it is evident that the time which each consumed in making its penetration, was not taken into the account, otherwise it would have been observed, that the effects which were apparently equal, were not so in reality. How little resistance is requisite to overcome a given momentum, if it has plenty of time to do so, is well illustrated by an experiment which is frequently exhibited in philosophical classes. The momentum of a small fly wheel is all at once thrown upon a piece of wire; the wheel's velocity is instantly checked, and the wire broke with apparent ease. The same momentum is then made to act on a few worsted threads; the velocity of the wheel is gradually checked by the stretching of the threads; but not one of them will be broke, although the quantity of dead weight which would have broke them, would have fallen very much short of what the wire could sustain.

Among the more modern advocates for the use of the square of the velocity, we find Mr. Smeaton; and it is a subject to which he dedicated much of his attention. In 1776, he

communicated an account of some experiments on this subject to the Royal Society. This paper is generally bound up in the same volume with his experiments on water wheels; and, as this book must be in the possession of many of your readers, a critical examination of it must be a very appropriate subject for your Magazine.

Passing altogether over his preliminary observations, we will begin at once with his definition of mechanical power. This power in descending bodies, he says, ought to be represented, by multiplying the weight into the height from which it has ascended, always keeping in mind, that in its descent, it must move slowly and deliberately, like the weight of a clock, or jack, "for, if quickly descending, it is sensibly compounded with another law—viz. the law of acceleration by gravity." This is a postulate to which the mind at once gives its assent, for the weight of a clock, or jack, in descending, say a foot, produces a certain mechanical effect, which will be equal, at whatever point of the weight's descent the foot is taken; in descending two or three feet, therefore, it produces a double or triple effect. This assumption, therefore, is perfectly correct; but in the succeeding experiments, Mr. Smeaton seems to have lost sight of the conditions which it demands, for, in every experiment, his weight descends with accelerated velocity, and his results are perfectly analogous to those derived from experiments on Atwood's machine.

Mr. Smeaton's apparatus consisted of an upright spindle, carrying two barrels at the top, for the reception of the cord which was to put it in motion. One of these barrels was exactly half the diameter of the other. The cord which might be wound at pleasure round either of them, passed over a pulley, and was attached to a scale, and this scale being loaded with a weight, served as the propeller of the machine; the impulsive force being varied, by changing the weight placed in it. Two arms carrying weight at equal distances from the centre of motion, were fastened upon the spindle near its lower extremity, so that the descent of the scale gave these weights a revolving motion; and by comparing the velocity generated in them, with the weight in the scale, and the length it had descended, the rotation between velocity and mechanical power might be obtained.

It would occupy too much room to mention particularly every experiment which he details; but it will be sufficient to select those which bear directly on the subject in dispute, and tend to prove that mechanical power depends on the square of the velocity.

1. The cord being wound ten times round the smaller barrel, and a weight of 8 oz. placed in the scale, it was allowed to descend. When the cord was completely wound off, the scale had descended $25\frac{1}{4}$ inches, while the revolving weights had acquired a velocity which carried them uniformly over 20 circumferences of their circle in $29\frac{1}{4}''$. The time which the scale took to descend was $28\frac{1}{4}''$.

2. The cord being wound $2\frac{1}{2}$ times round the same barrel as before, the scale descended in $14\frac{1}{4}''$, the whole descent being 6.3125 inches, and 20 uniform revolutions of the bodies were performed in $58\frac{1}{2}''$. In the first experiment, the measure of the mechanical power is $25\frac{1}{4} \times 8 = 202$; and in the second, it is $6.3125 \times 8 = 50.5$, only one fourth of the former; but the heavy bodies acquired half the velocity they had in the first experiment.

3. Thirty-two oz. were now made to descend with ten turns of the

small barrel; this was accomplished in 14″, and the uniform motion produced, was twenty turns in 14¾″. Here, again, the mechanical power was four times what it was at first, but the velocity produced was only one-half.

These experiments show decidedly that the mechanical power employed must be as the square of the velocity to be produced in the same bodies; but what Mr. Smeaton denominates mechanical power, is no proper measure of the force expended. Let us suppose, for a moment, that gravity is not a constant force, but that it acts by starts, giving its impulses at intervals of time sensibly distant from one another; and let f represent one of these impulses, t one of the intervals of time, and s the space described in the time t, in consequence of the impulse f. After the first impulse, s is the space described, and t is the time consumed; the second impulse would make the body describe another space s, even although it had been at rest when it received it, but it had previous to this impulse a velocity carrying it through s, in the time t; it will, of course, now pass over $2\ s$, in the same time; and, for any number of intervals, the impulses last given. The spaces described, and the times of description, will stand as in the following series:—

Interval,...	1st,	2d,	3d,	4th,	&c....*nth*.
Impulses,...	f,	f,	f,	f,	&c....f.
Spaces,.....	s,	$2\ s$,	$3\ s$,	$4\ s$,	&c....$n\ s$.
Times,......	t,	t,	t,	t,	&c....t.

The sum of all the f s, or $n\ f$, is the whole force expended, in generating a velocity $n\ s$, while $n\ t$ is the time in which it is generated. Hence it follows, that the force expended is proportional to the velocity produced, or to the time during which it has acted. But we have arrived at this conclusion, on the supposition, that gravity suspends its action for sensible intervals; the ratio subsisting between our quantities, however, are not at all affected either by diminishing t, or increasing n; they will, therefore, retain the same ratio when t is indefinitely small, or when gravity is supposed to be such a force as it really is.

It appears, then, that it is the velocity acquired, and not the space described, which is the true measure of the mechanical power. The space described is the sum of the series $s + 2\ s + 3\ s +$ &c. but each of these terms is not the measure of the cotemporary or corresponding impulse; thus, the second term is not the measure of the second impulse alone, but of both the first and second; the third term is the measure of its own impulse, together with the two preceding; in the same way, every term of the series, or, in short, the velocity corresponding to it, represents the sum of all the impulses, from the commencement up to that term. Mr. Smeaton, therefore, evidently assumed a wrong measure of mechanical power, for a weight moving with accelerated velocity; and it is evident also, that since the spaces described are as the squares of the velocities, the results of his experiments were altogether what might have been expected. At the time he wrote the definition already noticed, he appeared to be perfectly aware of the fallacy of the measure of power which he afterwards adopted; and it is remarkable that he should lay down, as a postulate, the very maxim which his experiments were intended to prove to be erroneous; for the purport of the postulate is, that, in uniform motion, the effect is as the space passed over by the moving body, and its weight jointly, and as the time consumed inversely. This amounts to the same thing as saying that the momentum is proportional to the weight into the velocity.

A more popular demonstration may be given of the error of Leibnitz, and those of the same opinion with him. Let a horizontal shaft have two barrels fixed upon it, the diameter of the one being double that of the other. A string being wound upon the smaller barrel, and another attached to the larger, so that when the former is wound down, the latter may be wound up; and if, by means of these strings, a weight of 1 lb. be suspended to the large barrel, and one of 2 lb. to the small one, they will balance one another. But let the 1 lb. weight receive a single impulse downwards, then the 2 lb. weight will be made to ascend, and as long as it continues to do so, its descent is obviously depending upon the descent of the smaller; for if either of the cords connecting them be cut, it will soon change the direction of its motion, and fall to the ground. Allowing, for a moment, that Leibnitz is correct, the force of the small weight is $1 \times 2^2 = 4$, while that of the large one is $2 \times 1^2 = 2$. The smaller body having double the force of the one whose motion it is preserving, it necessarily follows that their velocity will be augmented; but whatever augmentation the velocities undergo, their ratio remains unchanged, and the smaller body continues to have double the force of the other; of consequence, the acceleration will be continued *ad infinitum*. That this acceleration will not take place, it requires neither experiment nor argument to demonstrate, and we must conclude that our assumption with respect to the measures of the momenta was erroneous.

A. N.

8th June, 1824.

MISCELLANIES.

THE SCRAP GATHERER;

OR,

A Selection of Facts worth knowing.

"Science is not science till revealed."

No. 21.—Construction of Balloons.—For the purpose of exhibiting the ascensive power of balloons, they may be constructed of thin paper, varnished with lintseed oil, when they are to be filled with hydrogen gas. But if they are to be distended with rarefied air, it has been recommended to impregnate the paper with a solution of alum, sal ammoniac, or some other salt, by which the danger of fire from the materials employed in sustaining the rarefaction of the air is greatly diminished. The paper is cut in the usual way, and pasted together at the edges. An opening is left at the lower end of the balloon, in proportion to its size, for admitting the rarefied air, or the introduction of the matters by the combustion of which the heat is kept up. A small wire is passed round the orifice, and secured at its edges, to preserve the distension; and cross wires are placed within to support a light vessel, containing the spirit of wine, which is usually employed, or, what answers better, a piece of sponge, or a quantity of cotton thoroughly soaked with the same fluid. When the balloon is distended by bringing it near a fire, or holding a heated body under the aperture, the vapour of the spirit of wine from the sponge, or cotton, is set fire to; and, when the included air is sufficiently rarefied, the machine makes an effort to ascend in proportion to its size, and the rarefaction of the air.

22.—*Artificial Fire-works.*—This art has, for its principal object, to amuse the eye by the exhibition of bodies brilliantly illuminated, displayed in curious and pleasing forms, sometimes undergoing surprising and unexpected changes, moving with velocity through the air, throwing out innumerable sparks or blazing balls, or suddenly exploding and scattering abroad luminous spheres, that emulate in splendour the stars of the firmament. Few spectacles are more gratifying than a well-conducted display of fire-works; and hence they form a prominent part of those exhibitions by which it has long been customary to celebrate a triumph, or give expression

to rejoicing on particular occasions of festivity. They have also, of late, been made subservient to the destructive purposes of war; and, in the form of rockets, produce devastation not less terrible than that effected by bomb-shells, or red-hot balls.

22.—*Receipt for making good Writing Ink.*—The following are recommended by the celebrated Dr. Black, as the proportions of the ingredients in the composition of good writing ink: Rasped logwood, one ounce; best gall-nuts, in coarse powder, three ounces; gum-arabic, in powder, two ounces; green vitriol, or sulphate of iron, one ounce; rain water, two quarts; cloves, in coarse powder, one drachm. Boil the water with the logwood and gum to one-half; strain the hot decoction into a glazed vessel; add the galls and cloves; mix and cover it up. When nearly cold, add the green vitriol and stir it repeatedly. After some days, decant or strain the ink into a bottle, to be kept close corked in a dark place. The addition of the cloves retards any change that is apt to take place on the vegetable astringent. This change is apt to occur when the ink is long kept; and it is promoted by keeping it in a warm place, so that a cool and dark situation should always be selected in keeping it.

EXPLOSION OF THE AMERICAN STEAM VESSEL, ÆTNA, IN AMERICA.

When the public mind is under any strong excitement, especially if it be that of fear, it is incapable of receiving the suggestions of truth and reason with calmness and consideration; but such violent emotions gradually subside, and reason resumes her government. The late melancholy disaster, on board the steam boat Ætna, has sunk deep into the public feeling, and produced an agitation unequalled on any similar occasion. The cause of the misfortune was naturally first sought for, and as it happened in a boat having what is called a high pressure engine, it was at once assumed that the whole mischief arose from the use of this machinery, without reflecting that coincidence does not always prove cause and effect. The clamour against steam boats on this construction has been eagerly encouraged and inflamed by persons, whose motives *cannot be misunderstood*; but a just and generous community, when their agitation subsides, will not be unwilling to consider that a number of their fellow citizens have embarked an immense capital in this property, and before they suffer them to be ruined by those who have a clear and important interest in destroying them, they will candidly listen to such facts which ought to have an influence in deciding the question, whether the catastrophe so much deplored was really owing to the construction of the boat in which it took place.

It is my intention briefly to state and examine a few plain questions connected with this subject, by a reference to known and unquestioned facts; and to show that, whether we turn to reason or experience, the result is, that the high pressure engines are at least as safe, and, as both are now used, probably safer than the low pressure. We must not be misled by the terms *high* and *low* pressure, which, no doubt, have had much efficacy in misleading the public; they must be considered in relation to the strength opposed to them. The *high* is weaker, in relation to a boiler constructed to resist twice its force, than the *low*, in relation to a boiler made for half its force.

1. Was the Ætna lost by reason of the high pressure of her steam?

I do not undertake to state with certainty how this accident was produced; some chemical investigation will probably unfold it; but I think it can be demonstrated that high steam had nothing to do with it. It is a fact, that the boilers of the Ætna were carefully examined and cleaned but a few days before the accident, and found in excellent order, by engineers entirely competent to judge of them. It is a fact, that the boat, at the time of the explosion, was going with but 18 revolutions of her wheels in a minute, whereas her ordinary speed required 21 or 22, at which rate she has run for years without injury. There is satisfactory reason to believe, that the boiler which burst was exhausted, or nearly so, of water, and, of course, had but little steam in it; and, indeed, the slow motion of her wheels may be accounted for by her wanting the steam of one boiler. The pipe which conducted the water to feed the middle boiler, which exploded, was about two feet in length; and, for the purpose of passing round a flue, was crooked. This pipe has since been

found entirely stopped with a hard substance, derived from the sea water passing through it, evaporating by the heat. To the stoppage of this pipe, I believe, the whole disaster may be traced; its form and diameter were proper and sufficient for fresh, but not for salt water. It requires a scientific knowledge I do not possess, to ascertain the manner in which this cause produced the dreadful effect, and to ascertain what would be the effect of an intense heat applied to a small quantity of confined water, in decomposing it, and producing a gas fatal to life. Every one knows, that in all steam boats it is thought a matter of extreme danger to let the water get too low in the boilers. I am credibly informed, that no hot water issued from the burst boiler; that the persons killed were not scalded or wet, nor any of the furniture of the cabin, but the deaths seem to have been effected by suffocation from some foul and deadly air. This was particularly the case with the infant which was sleeping in the birth of the after-cabin, where surely no water reached. If these facts are correctly stated, the conclusion is irresistible, that the pressure of the steam had no agency in the accident; but the same causes would have been followed by the same effects in an engine of any construction or pressure.

2. Can we pronounce the high pressure engines to be more dangerous than the low, by reasoning on their respective constructions? The answer to this enquiry is decidedly favourable to the high steam. The Bolton and Watt's engines are calculated to bear a pressure of about seven pounds to the square inch; and are declared to be safe while kept within this limit; but they are actually worked in our boats under a pressure of from ten to twenty pounds. The boilers of the high pressure engines are tried and proved to bear a pressure of from five to six hundred pounds on the square inch; and are actually worked with but one hundred and fifty. The result is, that the former are under a pressure twice or thrice as great as they were intended to have on them, and the latter with but one third or fourth the pressure they have been able to sustain. These facts appear by the certificates of scientific and experienced engineers taken in 1817, under the direction of our City Councils. Are not then these engines or boilers safer with a pressure of 150 pounds, than the others with 20, or 15, or even 10. It being true that the high pressure boats really use but one-third or less of the force their boilers will bear, their owners cannot have the least objection to submitting to the restriction or regulation proposed; that is, that they shall be tried and proved at certain periods, and be permitted to carry only half the pressure thus proved. Indeed, to Mr. Vaux's circular in 1817, proposing to make a trial of the strength of the boilers of the Ætna, the proprietors replied that they were "not only willing but anxious to have the trial made as soon as convenient to the committee." Whether the owners of other boats were equally willing to submit to the ordeal, I do not know.

3. If this be the correct theory of the safety of these engines respectively, has it been contradicted by experience? Have boats on the high pressure been more liable to burst than those on the low? The Ætna has run in the Delaware for about ten years without injury or accident to any body; and the Pennsylvania has run for about six years with the like good fortune; indeed, with such perfect ease and safety did she bear the pressure, that she run for two seasons without losing one trip, going sixty miles every day. Had the Ætna continued here, or had her feeding pipes been enlarged to be suitable to the salt water, there is no reason to doubt she would have continued to go on without accident as heretofore. Nor, on the other hand, has experience shown an exemption of the low pressure boats from bursting their boilers:—witness the *Atalanta*; the *Bellona*; the *Eagle*, a few weeks since going into Baltimore; and the *Thistle*, a few days ago, since the Ætna; besides others more distant.

4. But it is pretended, that even if the high pressure be no more likely to burst than the low, yet when it does take place, the danger is infinitely greater; that in fact there is no danger whatever to the passengers in the bursting with low steam. One gentleman has said, the difference is the same as between chalk and gunpowder. What says experience on this point? A rupture of the boiler has taken place on board both the *Pennsylvania* and *Ætna*, without the least injury or alarm to any body. In one case, the water issued forth and extinguished the fire; in the other, the steam escaped from the boiler, which was speedily repaired, without injury. These instances are all sufficient to prove,

that the bursting of the boiler of a high pressure engine is not necessarily attended with violence and danger. It is not always gunpowder. Nor is the steam of the other boats always chalk. It cannot be forgotten, that when the *Atalanta* burst, two boys were killed, who were returning from or going to school. When the *Bellona* burst her boiler, several persons perished; the exact number I do not recollect, nor is it material. As to the latter disaster to the *Eagle*, a low pressure engine, it was equal or greater in destruction and force, to that of the Ætna. A passenger of the *Constitution* describes the *Eagle* as being "*a complete wreck.*" Captain Robinson gives this account of it:—He saw the Eagle enveloped in smoke, and making signals of distress. "I ran down to her, and, shocking to relate, when I got alongside, was informed that one of the boilers had bursted; one man, a United States' soldier, was killed, *who was lying in a birth in the forward cabin.* Mr. Murray, an eminent lawyer of Baltimore, very dangerously scalded; Captain Weems, and three or four of his crew, were also severely scalded." The Eagle was on fire, and Captain Robinson says, that, without relief, "she would in a very short time have been burned to the water's edge, and every soul on board must have perished." He proceeds, "the Eagle had cast iron heads in her boilers. The after-head of the starboard boiler burst into atoms; a piece of the cast iron went through the after-cabin as far as the ladies' cabin, tearing every thing away before it; the main body of the boiler went forward to her very bows, which killed the soldier in the forward cabin. I never saw so complete a wreck below decks." This is a fine specimen of the chalky nature of low pressure.

The damage resulting from an explosion does not depend upon whether it is done by high or low steam, but upon the part of the boiler which gives way. If it be a mere rent, no damage will generally be done; but if the heads be blown out, which may equally happen to both pressures, the danger will be extreme.

5. Are we to conclude, from these details, that all steam boat navigation is so dangerous, that it should be discontinued? By no means. They show, that vigilance and care are necessary in steam boats, as in every thing else; and that, even with vigilance and care, accidents cannot be certainly and absolutely prevented. When a man once gets off his legs for transportation, he will be exposed to more or less danger. He must trust himself with powerful animals, occasionally wild and ungovernable, or in vehicles, propelled by means he cannot always control. A steam boat accident has something terrifying in it; it happens near us; the sufferers are generally numerous; but were we to collect the injuries received from horses and carriages in a given time, they would be found more dangerous.

How is it in comparison with ship navigation? I may safely say, that in the wrecks of the *Albion*, the *New York* (sunk by an iceberg), and the *Paris*, there was a greater destruction of human lives and property, than by all the steam boats in the United States, from the commencement of their running, including a period of above sixteen years.

Let every caution be used in constructing the engine of both high and low pressure, and frequent examinations be made of their strength and condition, and steam boats will be found to be the safest, as well as the most easy, cheap, and expeditious means of conveyance.

JUSTICE.

GLASGOW SCIENTIFIC WORKS.

Dr. URE is about to publish a translation of the second edition of BERTHOLLET'S work on DYEING. This edition, which contains the author's latest improvements, has not, we understand, been before translated into English. The present translation will be enriched with notes by the translator. This work, which, we understand, will appear immediately, we cannot but anticipate with satisfaction; both because it must afford information, highly serviceable to the practical dyer, and as it must contribute to that connection between science and art which is essential to the progress of both.

The following works are expected to appear during the ensuing winter:—

"AN ATTEMPT to determine the ATOMIC WEIGHTS of BODIES," by Dr. THOMSON of this University. This work will contain the result of investigations, which have now occupied the learned Professor upwards of five years; it will

contain the analysis of several hundred salts, (a department of chemistry where much vagueness of statement has yet to be substituted by accurate investigation;) and, what is of most importance, it will demonstrate that the *Atomic Weights* of bodies, or, rather, (as we the think they should be called) their *Equivalent Proportions*, bear a simple relation to one another. Since the mighty stride which Chemistry took about twelve years ago, when the doctrine of equivalent proportions was first promulgated, we do not know any single original work which can be compared with the present, in the number or the importance of the determinations which it will add to the science.

Founded, as we understand, in some essential particulars on the determinations contained in the preceding work, Mr. THOMAS CLARK of this city, has announced "A NEW SYSTEM of CHEMICAL NOMENCLATURE; expressive not only of the component parts of Compound Substances, but also of the precise proportions of these parts." This has been accomplished by means chiefly of a new system of termination; thus leaving the greater part of the present names of substances unchanged, and capable of being recognised without difficulty, by those acquainted with these names. The proportions which the new Nomenclature will exhibit, are the equivalent proportions of the several bodies; so that, as will be perceived, in addition to the proportions of substances contained in any compound, it will exhibit the proportions of one body necessary to decompose another, as well as the proportions of compound bodies requisite for mutual decomposition. Beyond what would be readily anticipated from the comprehensiveness of its object, the new Nomenclature is simple; its names are sonorous and neat; and (no small advantage) it will be very easy to acquire.

Dr. HOOKER, of this University, has announced a work of very great interest, and one which has long been a desideratum in the most pleasing, if not the most useful of the sciences—we mean that of Botany. This work is to be entitled, A COMPLETE SYSTEM of PLANTS; and it will contain more extensive lists than have ever hitherto been collected. The author has, in a very praise-worthy and judicious manner, determined to divest the study of Botany of the repelling feature of a dead language. With the view of promoting the cultivation of the science amongst all classes of the community, at home as well as in our colonies, he proposes to adopt the English instead of the Latin names. This, it is obvious, is a point of the greatest importance to the student, as many must have been deterred from the study of this science, as well as of several others, by the formidable appearance of the names employed. In this way, indeed, very great obstructions have been thrown in the way to the acquisition of useful knowledge; and the individual who, like Dr. Hooker, is able and willing to reduce those technical terms that abound in science to the language of common life, merits the sincere thanks and the liberal support of the community.

In concluding these notices, we cannot but observe how singular it is to see so many important scientific works, all of them, save one, from names already distinguished in the scientific world, announced at once in a city, which is the point of some of its pert neighbours, as being a region of darkness, scientific as well as literary; where its benighted inhabitants, uncheered by the beams of knowledge, and heedless of their absence, grovel in the pursuits of beasts that perish. Such taunts, which have been sufficiently often repeated, the preceding notices serve substantially and successfully to refute. Interested, however, as our partiality is, we will not plead a universal exemption from the charge; for we are quite aware, that they who, through life, have been devoted to the pursuits of Mammon, have no heart for the charms of Science; and that, elated by success, they are to be found affecting to despise pursuits which they are unable to appreciate. The general diffusion of knowledge, however, now so extensively enjoyed in this city, will soon, we trust, extirpate the last remnant of a taste, unbecoming man, as an intellectual being, and calculated, if fully indulged, to level him with the brutes.

☞ Our Correspondents will be noticed next week.

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J. CURLL, PRINTER.

THE GLASGOW
MECHANICS' MAGAZINE.

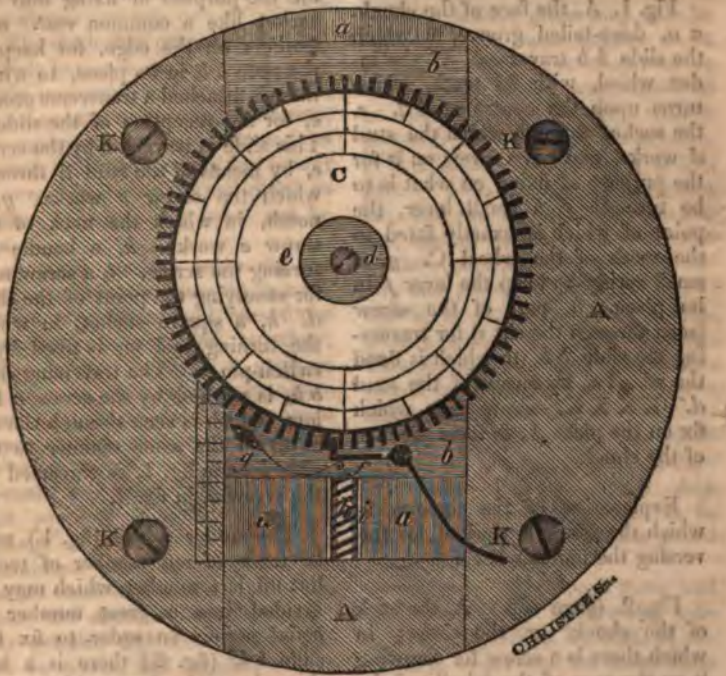
"There was an ancient sage philosopher,
That had read Alexander Ross over,
And swore the world, as he could prove,
Was made of fighting and of love:
Just so romances are; for what else
Is in them all, but love and battles?
O' the first of these we've no great matter
To treat of, but a world o' th' latter;
In which to do the injured right
We mean, in what concerns just fight."
Hudibras.

No. XXIX. *Saturday, 17th July, 1824.* Price 3*d.*

THE ECCENTRIC CHUCK,

A Machine for making Ornamental Workmanship.

Fig. 1.



For Figs. 2 *and* 3, *see pages* 456 *and* 457.

THE ECCENTRIC CHUCK,

A MACHINE FOR MAKING ORNAMENTAL WORKMANSHIP.

Mr. Editor,—The following is a short sketch of an eccentric chuck, which (among the many very useful machines that are so explicitly demonstrated in your Magazine) I think does not the least deserve a place. It is a machine which has excited considerable interest in the minds of mechanics, on account of its extensive utility in the ornamenting the finest workmanship, in every possible variety, if it is confined to circles.

I am,
Sir,
Your's, &c.
Opifex.

Johnstone, April 29, 1824.

Fig. 1. A, the face of the chuck. *a a*, dove-tailed groove, in which the slide *b b* traverses. C, the index wheel, with 96 teeth, which turns upon the centre stud *d*. *e*, the socket through which the stud *d* works, and has a screw on it for the purpose of fixing on what is to be turned. *f*, a small lever, the point of which is exactly fitted to the teeth of the wheel C. *g*, a small spring to keep the lever *f* in its place. *h*, part of the screw (seen through the slit *i*) for traversing the slide *b b*, to which is fixed the wheel *c*, by means of the stud *d*. K K K K, screw nails which fix on the plate A, to form the face of the chuck.

Explanation of the manner in which the screw is worked for traversing the under wheel:

Fig. 2. (page 456.) A, the back of the chuck. *a*, the socket, in which there is a screw for screwing it on the nose of the spindle of the *lathe*. *b*, the screw for traversing the slide *b*, in fig. 1. *c*, a stud which is fixed to the traversing slide, and through which the screw *b* works. *d*, another stud fixed to the chuck, through which the head of the screw works. *e*, the point of the screw, inserted into the socket *a*. *f*, a ruff to keep it in its proper place. *g*, the square head of the screw-pin, which is turned with a screw-key.

Fig. 3, (page 457,) is the *rest* which is used in turning with an eccentric chuck. It is composed of two slides, traversing each other at right angles. A A, the *rest*, which has a pin on its under side for the purpose of fixing into the socket like a common *rest*. *a a*, feathers on the edge, for keeping the slide *b b* in its place, to which there is attached a transverse groove *c*, for the reception of the slide *d*. This slide is traversed by the screw *e*, by means of the stud *f*, through which the screw *e* works. *g*, a notch, in which the neck of the screw *e* works. *h*, a handle for turning the screw. *i*, a screw nail, for steadying the point of the slide *d*. *k*, a square socket, in which the turning tool *m*, is fixed by a twitch-pin *n*. The traversing slide *b b*, is worked by the screw *o* below, (which is seen through the slit at *o*,) in the same manner as the slide *b b*, in fig. 1, is traversed by the screw *b*, in fig. 2.

The under wheel (fig. 1.) may be made of any number of teeth, but 96 is a number which may be divided into a great number of equal parts. In order to fix the slide *b b*, (fig. 3.) there is a bolt through to the lower side, represented by dots.

RECENT PATENTS.

To THOMAS HOPPER, *of Reading, in the County of Berks, Esq., for his Invention of certain Improvements in the Manufacture of Silk Hats.*

THE object of this patent appears to be to render the materials of which silk hats are made completely water-proof.

The woollen substance, which forms the basis, is first to be boiled in a solution of the supersulphate of alumine and potass, (common alum,) for two hours, in the proportion of two or three pounds of alum to a gallon of water. It is then to be taken out, well rinsed in clear water, and wrung, and immediately dipped in a solution of isinglass or glue of variable strength, at a boiling heat, and put on a frame to dry and give it a shape.

The cloth thus prepared, and before it becomes quite dry, may be again immersed in a strong solution of the acetate or tartrate of alumine, or supersulphate, and allowed to remain in the liquor for a few hours; it may then be rinsed and dried as before. This liquor must not be hot.

A third method is to dip the cloth, (previously alumed,) in a solution of gelatine, and one of the aluminous salts added together; when wrung, immerse it once or twice in an alkaline lixivium, afterwards let it be dried. By these processes, the gelatine is set or fixed in what may be termed the first, second, and third degree. In the last process, a double chemical change is effected, the acid of the aluminous salt leaves it, and attaches itself to the alkali, while its base, the alumine, combines with the gelatine and renders it insoluble in water, and together with it remains affixed to the cloth.

Various important advantages appear to be derived from the alumining process; it effectually removes the grease from the wool, by which, conjoined with its strong affinity for the cloth and gelatine, between which there exists but little naturally, it acts as a powerful intermedium in fixing the latter, enables it to resist the action of water, from the absorption of which, when used in its simple state, and consequent increase of volume, arises one of the principal causes of the disjunction, and falling to powder of the resinous gums. It prevents the cloth from shrinking in any sensible degree when subsequently wetted, facilitates the adhesion of the gums with the wool, and serves to equipoise those materials that are fusible by heat.

The resinous gums may now be applied in the same manner as at present practised, or they may be used in the humid way, dissolved in spirituous menstruum, with a proportion of Venice turpentine. It is usual to mix a third or fourth part of resin or sandaric with the lac, but the mastic is preferable, not curling up in cooling like the sandaric, and possessing more tenacity than either. It contains a substance, amounting to nearly a fifth, greatly analogous to caoutchouc. Caoutchouc, or elastic gum, dissolved in rectified oil of turpentine, and rendered drying by pure alumine, or by washed ether, or which is more economical, as much acetate of alumine as it will absorb: they should be rubbed together. It is, however, only intended as a partial application.

Between the resinous gums and the varnish, an intervening substance, not fusible by heat, is necessary, to prevent the latter from subsiding. Isinglass dissolved in weak spirit, gum acacia, simple or pure aluminous paste, &c. suffice.

The varnish, either that in common use, or the following, may be employed:—

Asphaltum, four parts; gum mastic, or gum anime, two or three parts; drying lintseed oil, from two to three parts.—Melt the bitumen and gum in an iron vessel, over a charcoal fire, then add the oil; when well mixed, remove the vessel from the fire, add venice turpentine two parts, and gradually six or eight parts of essential oil: strain, if it should be too thick; when cool, add more of the essential oil. The proportions here given admit of being varied.

[Sealed, 2d November, 1823.—Inrolled, May, 1824.]

To Richard Gill, *of Barrowdown, in the County of Rutland, Fellmonger and Parchment Manufacturer, for his New Method of Preparing, Dressing, and Dyeing Sheep Skins and Lamb Skins with the Wool on, for Rugs for Carriages, Rooms, and other purposes.*

The skins are first to be thoroughly washed in a running stream, so as to cleanse the wool from every kind of dirt; they are then to be stretched upon frames, the extraneous or refuse portions on the edges being trimmed off. The inside of the skin is then to be well scraped with a parchment-maker's knife, for the purpose of removing the grease and flesh which may have adhered; and afterwards, keeping the back of the skin upwards, and placing the frame upon trussels, it is to be covered with a solution of sumach and boiling water, in the proportion of a gallon of water to every pound of sumach. This material is to be spread over and well wrought into the skin with the knife before mentioned, by which means the skin will become tanned.

When the sumach is sufficiently dry, the reverse side of the skin is to be placed upwards, and the wool thoroughly washed with strong soap and water, and then with clean water until the grease is perfectly removed. After having been gradually dried in the air, the back of the skin is again covered with the sumach, and, when perfectly dry, any roughness is polished down with pumice-stone.

If the wool is to be white, it must be bleached, by placing it over the fumes of sulphur in a close vessel: it is afterwards to be carefully combed out, and the face dipped in water tinged with blue. But if the wool is to be dyed or coloured, its face must be several times dipped in a suitable menstruum; an extract of fustic is proposed, but many other materials will answer the purpose, and the colour may or may not be raised with a mordant, as shall be required. The wool should then be well washed, in order to get rid of the colouring matter; and after drying, dressing, and trimming the sides of the skins, the rugs are fit for use.

Sealed 24th July, 1823.—Inrolled September, 1823.

To James Surry, *of Battersea, in the County of Surrey, Miller, for his Invention of a New Method of applying Heat for the Producing of Steam, and for various other Purposes, whereby the expense of Fuel will be lessened.*

The patentee proposes to take advantage of the heat which is uselessly evolved in coke ovens, and to apply this heat to the generating of steam, for any purpose to which steam may be applicable, without any expense of fuel. To effect this object, he constructs metal pipes, which pass through the coke ovens from back to front, and keeps them filled with water from any convenient reservoir. These pipes

becoming heated by the combustion of the gas and smoke emitted from the coal, steam is generated within, which passes off through other pipes to the steam receptacle, ready to be employed as the motive force of an engine, or for any other use.

There are no drawings accompanying this specification to illustrate the mode by which this object is attained; and, indeed, the patentee does not confine himself to any particular form or construction of apparatus. The ovens, it is stated, may be erected in the usual way, and two or more pipes may be employed, but no very particular or definite instructions are given as to the erection; the invention consisting in taking advantage of the heat necessarily emitted in preparing coke, and applying this heat to the generating of steam.

[Sealed, 4th September, 1823.—Inrolled, November, 1823.]

To Richard Pew, *of Sherborne, in the County of Dorset, Esq. for a New Composition for Covering Houses and other Buildings.*

The composition herein proposed, is intended to produce an artificial stone, and the materials of which it is to be made, are as follows: the hardest and purest limestone is to be selected; that which is most free from any admixture of sand, clay, marl, or other such matters, is very much to be preferred; statuary's marble, if it could be procured in this country, would best answer the purpose; it is therefore recommended to select that material which approaches nearest to it in point of purity and hardness. These stones are to be calcined in a blast furnace, until all the water and fixed air, or carbonic acid is *completely driven off.*

Of this pure lime, when it has been reduced to a fine powder, take one part by measure, and add to it two parts of well burnt clay that has also been reduced to powder; or if burnt clay cannot be conveniently procured, powdered flints, the fine powder of limestone, or other hard substances capable of being reduced to powder, but such as is not soluble in water, may be employed; these are to be completely and intimately mixed together; then take one part of sulphate of lime moderately calcined, and reduced to powder, to which add two parts of the burnt and powdered clay, or other material before mentioned, and mix these together.

The two sets of powders, or compounded substances as above prepared, and in the quantities stated, are now to be combined, and well mixed, by stirring and working them for a long time until intimately united, when the composition may be considered complete, and fit for use, in which state if kept perfectly dry, and excluded from the air, it retains its virtue for a long time.

The patentee calls this composition Smalto, or Enamel, and proposes to mix it with about one-fourth its weight of water, so as to produce a tolerably thick paste. It must be mixed up with the water in small quantities, as it quickly hardens, and if allowed to do so, will crumble in using, and lose its cohesive properties in a great measure. It may be spread upon laths, or any other suitable foundation, and will become as hard in time as the most durable stone; indeed, the patentee considers the substance, when properly prepared, as altogether indestructible.

Into this composition, when in a powdered or plastic state, any desired colouring matter may be

introduced, which may be requisite for giving any particular hue to the artificial stone, especially in darkening the colour, which is proposed to be done generally by the admixture of lamp black, ivory black, pulverised charcoal, and several other colouring materials.

[Sealed, 17th June, 1823.—Inrolled, August, 1823.]

ON THE STEAM ENGINE.

Mr. Editor,—In your Number for the 1st of last month, I observe an animadversion on some of the rules connected with the steam engine, lately published in the *Compendium of Mechanics*, and being the compiler of that little work, I think it my duty to reply to M. S., and endeavour to explain the subjects which appear to puzzle him.

I shall therefore be obliged by your communicating the following through the medium of your excellent Magazine:—

Steam arising from water at the boiling point, has a pressure of 15 lbs. on the square inch.

The safety-valves of steam engines, are generally loaded with 3 lbs. on each square inch. The pressure of the steam, therefore, when escaping at the safety-valve, will be 3 lbs. more than the pressure at the boiling point, or 3 lbs. more than the atmospheric pressure; and consequently, will rush into a vacuum with a resistance of 18 lbs. on each square inch.

These are truths which cannot be contradicted; and a natural question arises, which is—For what reason is the safety-valve loaded with 3 lbs. on each square inch?

It is well known, that an engine only requires steam in proportion to the quantity of work it has to perform; and, when the steam is at its greatest admissible pressure, it is evident that the engine is loaded to its full power, which rarely takes place; consequently, it is very seldom that steam escapes at the safety-valve. The load on the safety-valve must therefore be, to insure a constant supply of steam at the pressure required, and provide for all waste of steam that may unavoidably occur.

M. S. appears to have fallen out with the Table of the length of strokes; and has condemned it in what I think a rude hasty manner. I will therefore only say, in reply to his rather premature decision, that the engine he alludes to has not been working at its maximum.

With respect to the quantity of cold water required per minute for a horse power, I will quote a Table taken from a late publication, entitled, Robert's *Mechanics' Assistant*, which gives, upon an average, 5.5 ale gallons per minute, equal to 6.7 wine gallons. Now, what I have given is 7½ wine gallons—(if M. S. will take the trouble to read *attentively* the latter part of the Article, *Cold Water Pump*, page 105, he will see that it is wine measure which is used.) This I conceive to be an ample supply, but nothing beyond the quantity required to take any significant power from the engine.

I have no doubt but M. S. has seen engines working with a supply of only 3 gallons per minute for each horse power; but these engines could not possibly be doing their duty, when their condensing water was scalding hot, and which in one case he admits.

I have no wish to enter into any dispute about the various rules contained in the *Compendium of Mechanics*; nor to attempt to bolster

up any errors that I may have inadvertently committed in compiling it. The rules were collected for my own personal use, and gleaned from the best works on mechanical subjects which I perused. I trust, therefore, that few errors will be found, and those few have no evil tendency in leading the mechanic astray in his operations.

I am, SIR,
Your's respectfully,
ROBERT BRUNTON.

London, June 16, 1824.

TABLE extracted from ROBERT'S *Mechanic's Assistant*, page 18.

Horse Power.	Ale Galls. per Minute.	Horse Power.	Ale Galls. per Minute.
10	55.30	18	101.
11	59.60	19	106.
12	66.	20	111.80
13	73.	21	118.
14	82.50	22	126.50
15	85.	23	132.50
16	90.	24	136.
17	95.	25	142.

ON SINGEING WITH GAS.

MR. EDITOR,—Having been some time from home, I have not had the opportunity of seeing several of the recent Nos. of your Magazine; but, having supplied myself with them on my visit to this place, I find that "N. P.'s" address to you in No. 19, and my reply to it in No. 21, have been productive of no less than three more letters. The first, in No. 22, signed "A Friend to Improvements," deserves no notice, both on account of its being anonymous, and the little merit and candour it possesses: I shall therefore only remark, that instead of being dated Chester, it would have been more correct had it been dated *Man*-Chester; and there would have been more ingenuousness displayed, had it been signed *John Burn*, instead of "A Friend to Improvements;" for I am prepared to show that he was the writer of the article so highly laudatory of what he pretends to call his own plan.

With respect to the letter, in No. 22, signed "John Ferguson," and that signed "John Hart," in No. 26, I am surprised that sensible and liberal men should write in opposition to the plain and unequivocal facts which I have put into their possession, and without obtaining further information respecting my claims, and the nature of my inventions, which they might so easily have done at the Patent Offices. Both these gentlemen allude to an apparatus fitted up for a manufacturing house, in 1822: one of the partners, whose respectability cannot be questioned, paid me a visit some time ago at my works at Basford, to whom I showed my apparatus for singeing with gas, and no doubt he would communicate to those gentlemen what I had practised five years before he applied to them to fit up an apparatus; if so, I have great reason to complain of their want of candour, for how can they for a moment question my claim to priority in this invention?—how can any thing done in 1822 by others, interfere with it, or prevent my *challenging in this quarter* (to use Mr. Ferguson's own words) *the right patent to singeing with gas*, my patent for Scotland being taken out in 1817.

As to the particular apparatus described by Mr. Hart, I freely give him all the merit of it, but I am afraid it will be found of a negative description, as I have no he-

sitation in asserting, and without fear of contradiction, that the plan he has described will not singe muslins to any degree of perfection; and I have here again reason to complain of Mr. Ferguson's want of candour, in not giving that as the real reason for Messrs. Chisholms giving it up, but in stating that it was discontinued by them on account of the wiry appearance of the cloth singed by this means, which quality no doubt others as well as myself will rank among its advantages.

I will only add, that if Mr. Hart's plan would completely succeed, no one could legally use gas with his or any other apparatus during the term of my first patent, which, as I stated in my former letter, claims the exclusive use of gas, by whatever modification of machinery it may be applied.

I shall not here explain the nature of my second patent, as I shall have some machines at work in a few weeks, in this city, which I shall have great pleasure in showing to Mr. Ferguson, Mr. Hart, or any other gentleman who may wish to see it.

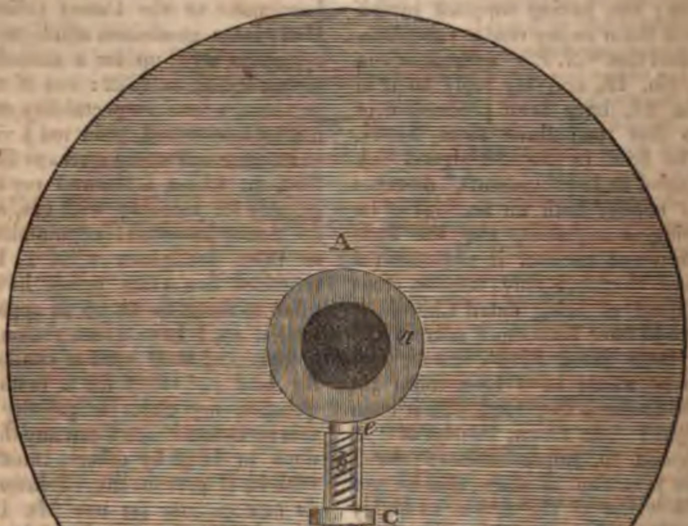
I am, SIR,

Your obedient Servant,

SAMUEL HALL.

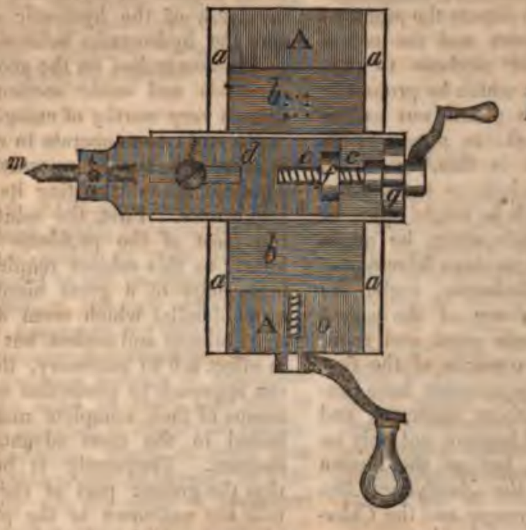
Glasgow, July 8th, 1824.

Fig. 2.



For Description, see page 450.

Fig. 3.



For Description, see page 450.

APPLICATION OF MECHANICS TO THE ARTS.

SIR,—The following is the introduction to a series of articles, on the APPLICATION OF MECHANICS TO THE ARTS, which, if agreeable to your wishes and that of your numerous readers, I propose to publish, from time to time, in your Magazine. I observe that a number of articles have appeared, and are in progress, *on the Principles of Mechanical Philosophy*, and I should think that the former, if properly executed, will form a very appropriate companion to the latter. Theory and practice will thus go hand in hand, throwing light upon one another, and producing the best effects among a class of the community who are of the utmost importance to its prosperity, and whom the increased knowledge and the liberal views of man in the nineteenth century, have raised to their proper place in the scale of society.—I am, SIR, your's,

PHILOMECHANICUS.

London, June 25th, 1824.

Mechanics, the most important branch of the physico-mathematical sciences, is divided into two parts, which it is of importance to distinguish from each other, because though they have the same origin, yet their end is different. The first, purely speculative and theoretic, is denominated *rational Mechanics;* it has for its end the general determination of all the laws of the equilibrium and the motion of bodies, and the application of these laws to the interpretation of the principal phenomena of nature. The end of the second is the

immediate application of these laws to the uses of society; hence it is denominated *practical Mechanics*. It is this which directs the practical man in the choice and the use of the most proper methods to produce the effect which he proposes; it is this which points out to him the way he ought to pursue in his operations; it is this, in short, which teaches him to avoid those rocks on which he might split, or those quicksands where he might be lost in his ingenious labours.

Rational Mechanics, under the persevering culture of the ablest hands, has made great and rapid progress. Two works of the first rank in this department have rendered their authors immortal, and have conferred honour, not only on their country, but on the human race; I mean the *Analytical Mechanics of Legrange*, and the *Celestial Mechanics of Laplace*.

Practical Mechanics have been also cultivated, but by fewer scientific men than the former; with less assiduity, and with less distinguished success.

It were desirable that philosophers, who seldom deign to descend from the vast domain of their abstraction from the objects of sense, would more frequently direct their profound meditations to a great number of problems in practical mechanics, hitherto unsolved. Such problems will not certainly be so sublime as those with which they are habitually occupied, but they will probably be more fruitful. Their solution will not perhaps excite the admiration of the learned, but they will procure the gratitude and the esteem of their fellow-citizens, of whom they will be the benefactors. Archimedes had a greater regard for his purely geometrical labours, than for the useful mechanical inventions of which he is the author; posterity has not ratified his judgment; and he owes his high renown, more to his defence of Syracuse, to the invention of the hydraulic screw, and the hydrostatic balance, than to his researches on the geometry of solids and conic sections, although very worthy of eulogium.

Several causes operate in retarding the progress of *practical Mechanics*, notwithstanding its great importance. First, the solution of the most of the problems which belong to this subject requires the knowledge of a great number of small details, which seem at first sight minute and useless, but which in effect are so necessary, that we can approach to perfection only by means of their complete union, effected in the most advantageous manner. Frequently it happens that the greater part of these details are unknown to the philosopher, who thinks that they are of too vulgar a nature to render them an object of study. The result is, that he rarely applies himself to practical mechanics; and, when he does, his researches are not always crowned with the desirable degree of success. Secondly, practical men, to whom these details are familiar, either neglect or are ignorant of those theories which could point out to them the defects of the methods they follow—methods which they have only adopted by mere rote, and which they blindly employ, without knowing how to appreciate their advantages or disadvantages. To these two causes may be added a third, namely, the share of disgrace which is thrown upon useful improvements by those swarms of ridiculous or insignificant inventions which spring up daily, teeming with the folly of ignorant persons who have the mania of believing that they are mechanicians by inspiration; similar in every respect to the alchemists,

of ridiculous memory, like them, they laboriously consume their time in vain researches, (such as the *perpetual motion*—see London Mechanics' Magazine, *passim*,) and neglect their professions; like them, they often lose their property and peace of mind, in pursuing with obstinacy a chimerical hope of success.

(To be continued.)

POPULAR MATHEMATICS.

SIR,—The appearance here of a Glasgow weekly publication of such evident utility as your Magazine, produced in me no small sensation of pleasure, not only because it reflects honour on my native country, but because it is calculated to rouse the dormant feelings of emulation in the mind of every one who is at all addicted to literary or scientific pursuits. Such, at least, was the effect it had on myself, as I instantly felt the glow of unfledged authorship rising in my breast, and fired with the brilliant prospects of fame which my fancy drew before me, I determined at once to commence my scientific career in your work; and as I intend soon to be in Scotland, you may depend on my becoming a regular contributor. I have said that my career is to be scientific, and I shall, before proceeding farther, state my reasons. I observe in your Magazine, several illustrations of mechanical subjects, which, it is well known, cannot be properly understood by such of your readers as are unacquainted with the mathematical sciences; and as these sciences are absolutely necessary for the foundation and groundwork of mechanical science, as well as for its calculations and application to the business of life, I conceive that a simple and popular course of the former should precede, or at least accompany the latter.

Impressed with these views, I purpose to transmit for publication, if found acceptable to you, as well *as the readers* of your Magazine, a short and simple explanation of the elementary principles of Algebra and Geometry alternately, in a series of articles, which I shall take care not to extend to more than a *page at a time, at the utmost.*—These articles, while they will explain the principles of those sciences in the easiest manner, will always have a reference to practical and mechanical questions, and will be illustrated, whenever it can be done, by means of mechanical contrivances. The elements of Algebra are too often delivered in a dry and unentertaining manner, and the learner is too frequently kept for a great length of time at processes, of which he does not see the immediate use, although it is very evident that he might very soon be made acquainted with their utility in the solution of practical questions. To remedy this, not only because it is the fault of almost all works on the subject, but because your pages are limited chiefly to the results of science, I shall introduce to the notice of your readers unacquainted with Algebra, the use of their various processes along with their explanation, and will show how to solve questions almost at the outset, which are frequently deferred till considerable progress has been made in the science.

In explaining the principles of Geometry, I shall depart in an equal, if not greater degree from the common mode. Euclid's Elements, though a very excellent work, as the fact of its standing

two thousand years, has shown, is perhaps not well calculated for commencing the study of this science, and on account of its abstruseness in many places, has proved a stumbling-block to learners.—Aware of this, the French have discarded it altogether, and have introduced much shorter explanations of the principles of Geometry into their schools. Aided by such guides, whose superiority over us in the mathematical sciences is unquestionable, as well as by occasional mechanical illustrations, I shall endeavour to render this branch more attractive to mechanics than it generally is found to be. Lest, however, you should think I am taking up too much of your paper, with the explanation of my plans, without giving you the plans themselves, I beg leave to conclude for the present with, Sir,

your's, &c.

SCOTUS.

Paris, June 18th, 1824.

DESCRIPTION OF VETTIE'S GIEL.

(Continued from page 428.)

The farther we advanced in Vettie's Giel, our road became the more difficult and the more frightful. At one time you were stopped by snow that had tumbled down, and where it was only by passing quickly over the loose heaps you could avoid sliding down the steep, at once to be dashed against the rocks and to be drowned:—next you stood horrified at the sight of a wall of ice, the remainder of a frozen current, by which all farther advance seemed to be rendered impossible. But for this Civind had prepared himself. With his axe he cut in the clear solid ice a notch, in which he set one foot; then another, in which he set his other foot; and in this manner continued to cut and go forward till he had reached the other side. The rest of us followed in the steps which he had thus cut. You must put on resolution; there is nothing else for it. With the utmost caution, your eye fixed steadily on the point where you are to tread, you set forward foot by foot, without stopping to draw your suppressed breath. For more than half a mile, (more than three English miles,) we went forward on the brink of a perfect abyss, in this manner, sometimes passing masses of snow not yet melted, sometimes those huge frozen mirrors which hung almost perpendicularly from the summit of the mountain to the gulph below, and over which the axe only, by steps scarcely a handbreadth, could form for us a dangerous path. A slip, an unsteady step, *or giddiness itself*, which always threat*ens to overwhelm* the unaccustomed traveller, and in a moment the torrent becomes the grave of your mangled carcase. But such is your whole course through Vettie's Giel, on a path where it is not often you can set down both feet beside each other.

When overcome by the violence of the exertions I had to make, I stopped a moment. This rest, so far from being refreshing to me, was full of horror. It was better to go on, however exhausted. In doing so, your thoughts were so occupied with the place where you might find some footing, that you had but little time to observe the grimaces with which death seemed every where to gape around you. But set yourself down, you cannot avoid seeing yourself sitting on the brink of an abyss; above you, the high mountain ridge hanging over your head; below, the more frightful steep sinking perpendicularly from your feet: on the opposite side of the Giel, the wildest torrents tumbling down hundreds of fathoms; whilst at the bottom, the river foaming and roaring, with a deafening sound, rushed on with the rapidity of an arrow, and the road you had to go, bent still far upon the sides of the precipice which hung over it: in short, you saw nothing but Nature in her terrors: I involuntarily shut my eyes; my heart beat, and, that I might not be overpowered by these sensations, I stood up, to expose myself to new dangers. I asked my guides if any body had ever come to mischief on this way. They recollected only one person, who, with a knapsack of birch-bark

on his back, by a false step, had tumbled over from about the very spot where we were standing. From an irresistible apprehension that I might be the second, I pushed forward from such a place, but yet I found no safer way.

It began now to rain, and as the part of the path on which we were was considered as dangerous, from stones that tumble down, we made all the speed we could. The bottom of the Giel began at last to widen a little; and at Hölifoss, about half a quarter of a mile from Vettie, (three quarters English,) it becomes about 150 paces broad. In other places it is never above 30 ells broad, and in some places not more than six or seven. Here my guide Civind left me, and went back alone with his axe, of which he had made such good use, telling me, that now all the difficulties of the way were past; and they were so in comparison of those we had come through.

It rained now so hard, that the water ran across our path: I quickened my pace, to reach the end of this fatiguing and dangerous excursion. With all my haste, however, I could not escape being thoroughly wet. The path now descended gradually towards the river. The mountain, to the side of which, as to a wall, we had been, as it were, fastened the whole way, now turned a little off from us, leaving a broader, though an irregular way. On a sudden it goes off entirely to the right, opening a new side-valley, and, before I knew where I was, I stood on the fields of Vettie, only a little above the surface of the river. Heavy with my wet clothes, dropping with sweat, and exhausted by violent exertions, I was glad to reach the houseman's dwelling, which lay nearest us, there to repose a little, under cover, before I should attempt to mount the long and high hill on which stood the farmhouse of Vettie.

On the road to it I was met by Olé, the goodman, who conducted me up. The family had just risen from dinner. Every thing was instantly carried off, as they did not think it good enough for me. On the table was immediately set their best butter and cheese, and smoked flesh, and flour-bread; and, in short, every thing they had to please the appetite of the weary traveller. But, as there was not a dry thread on me, I felt very uncomfortable in my wet clothes. The goodman found a remedy for that; and from his chest I was provided with every thing I required. Clad from top to toe in his Sunday's clothes, I sat down, metamorphosed into a Leirdaller, amidst this friendly family, who could not cease from expressing their wonder at a visit as unexpected as unheard of before, and who did not know what kindness to show me; complaining, from their hearts, that I had not given them notice, that they might have been better prepared to receive me. His wife was in an advanced state of pregnancy. I expressed my wishes for her safety on her approaching confinement; and asked her, How she would get the child taken to church.—O, answered she, smiling, when matters come that length, there will be no difficulty: the child is well wrapped up, and is carried to church, properly girt, on the shoulders of the servant-man.—By the same way I have come?—Yes; we have no other.—Now, then, God be with both him and the child.—O, we are not afraid of the way, we are so accustomed to it; and after a few weeks it will be better, when all the ice will be away. By God's help I shall soon come to church myself, when Father* shall lead me in.—I could not but think highly of her courage, her cheerfulness and composure. The goodman told me, that at the best season in summer the Giel can be traversed by a horse; and that then every thing is thus brought to the house, on the back of his own horse, who is accustomed to this road. One is less surprised at this, when he sees the lightness of the small Leirdal horses, and their most uncommon sure-footedness, by which they can go on the smallest paths, on the side of the most fearful precipices, setting one foot before another, in such a manner that no path can be too small for them. From the farm of Vettie, the Giel is continued upward, in a stretch of three miles, so that the whole length of it is more than four miles and a half (more than thirty English miles).

(*To be concluded in our next.*)

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* Meaning the clergyman to whom she was speaking. It is still the custom, in the remote and simple districts of Norway, that when a woman goes first to church after her confinement, the parish clergyman meets her at the door, and leads her into church.

STATEMENT *relative to the Discharging Process of Turkey Red, by means of Presses.* *By* MR. JOHN MILLER.

A NUMBER of statements relative to the invention of the discharging process of Turkey-red, by means of presses, were made through the medium of the Glasgow Mechanics' Magazine, which seem to call for a few observations on my part.

I will take no advantage of the strange inconsistencies in the statements, relative to the respective claims to this invention, by Mr. George Rodger, and by Mr. David Campbell; and it is not necessary, nor am I disposed, to dispute their merit in what they actually did accomplish. For, whatever this may have been, it was, at the time of my invention, totally unknown and unguessed at by me. Whatever, therefore, their merit or mine may be, they stand on grounds altogether different, at least prior to December 1803, when, as has been proved, a person in the employment of Messrs. Monteith & Co., and also a partner of that house, saw my original model. *

Now, what was it that Mr. Rodger and Mr. Campbell did accomplish? Mr. Rodger, who certainly has the merit of having turned his attention early to the subject, used, it seems, *flat boards* bored with holes. Such an apparatus, though it might, out of many, produce some specimens fit for looking at, every body knows, never could answer for a manufacturing process. The wood was unfit for great pressure; it would allow the liquor to spread; and it would thus produce a ragged spot, instead of a regularly defined figure. The mahogany boards, which Mr. Rodger seems chiefly to have employed, were but ill calculated to lessen these effects; as, though mahogany is a very hard wood, it is exceedingly porous. The effects which I have stated, are precisely those which Mr. Campbell has said actually did take place upon a trial of the boards being made.

But what does Mr. Campbell say for himself? He says that he used *large flat plates*, of a mixture of lead and tin. The use of metal, certainly, was so far an improvement. But it would be impossible to work regularly with such plates. They would not answer with the present open patterns, and the immense pressure at present applied; much less with the spotted patterns, and any pressure Mr. Campbell is likely to have then commanded. The inconsistency, however, of Mr. Campbell's statement with that of Mr. Harvey, leads me very strongly to doubt the correctness of Mr. Campbell's recollection altogether, especially with respect to the time when he says he made his plates. But whether I am right or not in this supposition is of little consequence; both because, as I have already stated, I knew nothing of these plans, whatever they were, and because my invention was essentially different from those of either Mr. Rodger or Mr. Campbell.

My plan consists of two plates, with holes cut in them both, corresponding with the pattern it is wished to produce. Its essential distinction is a *bondage*, or raised part, round the holes in the upper plate. The use of this bondage is, that, as it greatly diminishes the surface on which the pressure acts, it consequently proportionally increases the power of that pressure. It was his bondage which was the first thing, and, so far as

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* See page 140.—It was ridiculous in Mr. Harvey to question this fact. The letter of Mr. Tweedie proves it beyond doubt. Was it reasonable, or candid, to question the veracity of an honest man, supported as Mr. Barr's was, by the strongest evidence, on the ground that he did not recollect the names of persons, concerned in a transaction, which took place 22 years ago, and of which he never professed to have been an eye-witness? He warned me that persons were coming from Blantyre; because, as he told his "interrogator," he thought it right to protect a poor man from being robbed of his invention. Besides Mr. Tweedie, there was Mr. John Strathairn, who is yet in the employment of Messrs. Monteith & Co.; there was Mr. Colin MacCallum then likewise in their employment; and there was another person whom I did not know, but who is likely to have been Mr. George Rodger; as, so far as I can learn, he was the only other person in the employment who had a charge in this department. In making this statement, they, who are most concerned, are aware that I exercise forbearance in withholding the name of the "interrogator." I could enter into other details of this kind, but I am unwilling; and I mention the above details only because an unjust attack upon my friend's character *renders it necessary*.—J. M.

I know, the only thing, which ever put it into our power to produce defined figures by presses. It is hardly necessary to say that this bondage is, to this day, the most essential part of the plates in use.

Mr. Harvey, to a certain extent, describes my process correctly; but when he states, that the types I employed cut the cloth, I must be allowed to question the accuracy, not of his knowledge, (for I presume he proceeds on the testimony of others,) but of his information. To me, the fact is a new one; and to all who are acquainted with the subject, it is well known that such an effect could only be produced by gross carelessness, either in allowing the types to be worn too thin, or in applying a greatly over-adequate pressure. This effect, therefore, if it ever was produced, ought to be attributed, not to the apparatus, but to the perverse ignorance of the operators. Would we not laugh at a man who rejected the use of the razor, because it took from his chin, not the beard only, but also the skin? And yet it is capable of both.

It is nevertheless quite true, as Mr. Harvey states, that the discharged part of the Turkey-red was sometimes found to fall into holes. The reason of this is to be found in the discharging liquor, which, at the commencement of the manufacture, was, by some, allowed to contain vitriol; which, in other cases, was used too strong, in too great quantity, or allowed to stand too long on the cloth, unwashed. The centre of the discharged portions of the Turkey-red cloth is most exposed to the action of the discharging liquor; because the centre undergoes least pressure. Accordingly, in all holed handkerchiefs, on which I have been able to lay my hands, it is in the centre where the holes break out; whereas, on Mr. Harvey's supposition, they would break out at the edges. The same effect, owing to the same cause, is also produced by the lead plates now used.

One would be led to suppose, from the statements that have been made, that my invention was confined merely to types. This is so far true, as it was at first applied chiefly to making diamonds, clubs, and the like, for which types are best fitted. But my very first model had the bondage made of lead; and I gave up the use of this metal, on account of the great additional pressure it required. The following pattern of my second model (made probably about the commencement of 1803) will, however, show that the farther application of my invention had not escaped me.

This, unquestionably, is the first flower ever discharged on Turkey-red cloth.

It may be here proper to insert the following attestation:

"The models which Mr. John Miller still preserves of a discharging apparatus, with seven varieties of pattern, comprising round holes, diamonds, clubs, and one of them a flower, were all made by me, according to his instructions, long ago. I cannot exactly state the date; but, from a variety of circumstances, I think it was on or before the year 1803. I recollect also of making about the same time, a model for another flower, which was destroyed in making trials, and in which Mr. Miller introduced the chintz colours.*

"JOHN BOWMAN.

"Bridgeton, 31st March, 1824."

* These models I will be glad to show to any who wish to see them, any evening after six, at my house, No. 180, Hill-Street. Specimens from all the models I leave for inspection, at the offices of the Glasgow Mechanics' Magazine in Glasgow, Paisley, and in Perth.—J. M.

This is from a respectable block-cutter, now in the employment of Messrs. Monteith & Co.

I ought not to omit that I was the first person who employed the bleaching powder, for the purpose of discharging Turkey-red. It must be well known how much this contributed to facilitate the introduction of the process. Fifty presses, which had been made in Glasgow, were all working at once, a few years after my invention became known. All of these were, in every respect, made according to the first press constructed under my direction. Several of them were wrought by Messrs. Monteith & Co., whom their servants thus put in a very strange light, by representing them as employing a process which proved destructive; (it did not do so in other people's hands;) and at the very time they were in possession of a much better process which had been long before invented by their servants.

Mr. Harvey says that I have "presumptuously thrown myself on the generosity of the public." Mr. Harvey knew that the statements which appeared in the Glasgow Mechanics' Magazine were not written by me, but by a disinterested young gentleman, whose only object could be to serve what he conceived to be a just cause. I saw none of the statements till they arrived in London after they were printed. But I willingly pass over this, and other topics of abuse. My grey hairs must learn to shade a contented brow, while, in the words of my young friend, "notwithstanding the wealth which individuals and the community have gained by my invention," I have not only "never received from it profit, nor reward," but am even, by those whom it has enriched, grudged and denied the poor recompense of THANKS.

JOHN MILLER.

Glasgow, 14th July, 1824.

GLASGOW GAS.

The improvements in the apparatus at the Glasgow Gas Works, alluded to in the July Report of the Committee of Management, by which the gas is rendered greatly purer than formerly, Sub-acetate of Lead being employed as the purifying medium, were, we understand, adopted at the suggestion of Charles Mackintosh, Esq., F. R. S.

NOTICES TO OUR CORRESPONDENTS AND READERS.

The following Communications will be inserted as early as possible:—Mr. D. Hatton's *Chamber Flute-orum;* Mr. Joseph Wrigley's (of Manchester) Suspension Bridge; Mr. Saul's (of Lancaster) Revolving Window; Messrs. Lane and Saul's Fruit-Gatherers, and Mr. Allan's (Pennycuik) Snow-Plough, and Bee-feeding Box.—M. A. will please to send his address.—J. F. and J. P. will please to call for a note at the publisher's.—B. must be deferred *sine die*.—The idea of a "Constant Reader" is good, but impracticable for a very obvious reason, which, we wonder, did not occur to himself.—An 'Old Mechanic' under consideration.—'Investigator' has fallen upon a subject which cannot really be resumed; we thank, him, however, for his hints.—We are in arrears with A. B. and D.; but we trust to be able to insert their valuable communications very soon.—The solution which J. D. C. has kindly sent us, is, we fear, too long; we have received one considerably shorter from another Correspondent.

Envy at the success of our Magazine has produced attacks upon our work in two quarters where they were least to be expected: A Gallowgate grocer, whose signature is G. F., indignant at the rejection of his communication, (for which, by the bye, our readers thanked us,) and exclaiming

"S'death, I'll print it, and shame the fools,"

has thought proper to publish his lucubrations; and, as commonly happens, in such cases, has only made public his ignorance, which otherwise might have remained unknown, by pretending to a 'new discovery in algebra,' that far transcends the rules of "Thomas Simpson, one of the most minute analysts of *which* this country can boast." Those who are acquainted with the subject, will, of course, see nothing new in this boaster's plan, which, had he had the good sense to keep to himself, would have saved him from an exposure. Like a drowning man catching at straws, he has discovered two or three trifling inaccuracies in our columns, wholly unworthy of notice, but sufficient for a sage Dogberry, as he appears to be, to bring forward as capital reasons for our neglect of his communication.

A Cotemporary Work of the same description with our own, has also sounded the tocsin of war in its pages; and, since matters have come to this pass, though desirous of peace, in so far as compatible with justice, we shall not be slow in returning the compliment, in our own defence, and in showing to impartial readers how far this attack is unjust and unwarranted; and that it originated in a sinister design, which will only injure its own cause. We are prepared to show, from internal evidence in the article alluded to, that it was written in Glasgow, and sent to London for publication; and, if we may offer a conjecture, it has for its author, the *abler* editor of a *certain recently defunct periodical*, whose "bright coruscations" have been at last finally obscured by its total decadence in the *West*. In the mean time, we must crave the indulgence of a host of Correspondents.

Published every Saturday, by W. R. M'PHUN, 155, Trongate, Glasgow, to whom Communications (post paid) must be addressed; may be had also of STEUART & PANTON, Cheapside, London; and EDWARD WEST & Co. Edinburgh.

J. CURLL, PRINTER.

INDEX TO VOL. I.

C

D

☞ Several articles which were intended for insertion in the Supplementary Number, have been unavoidably excluded, owing to the great length of the Index, which we have endeavoured to make as useful as possible. Among these, were an interesting abstract of the Third Report of the School of Arts in Edinburgh, an institution which, we are happy to observe from the statements contained in this Report, appears to be in a very flourishing state; and Mr. Miller's statement relative to the Discharging Process of Turkey Red, by means of Presses, an article which, from its nature, could not be so easily deferred, and which, therefore, was inserted in No. 29.

ERRATA.

In some copies, page 462, col. 1, line 15 from the bottom, *for* Campbell, *read* MacCallum; and page 463, col. 2, line 2, *read* the sentence begining with the words, "The same effect," after line 47, col. 1.

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J. CURLL, PRINTER.

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